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# ONTARIO SEDIMENT-RELATED LITERATURE: ANNOTATED BIBLIOGRAPHY

G. G. BINDA

WATER RESOURCES BRANCH
INLAND WATERS LANDS DIRECTORATE
DIRECTION DES RESSOURCES EN EAU
DIRECTION GENERALE DES EAUX INTERIEURES ET DES TERRES

Canada

SEDIMENT SURVEY SECTION
IWD-OR-WRB-SS-87-1

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BY
G.G. BINDA
CONSULTANT

IWD-OR-WRB-SS-87-1

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## ABSTRACT

This report consists of a compilation of reference material pertaining to sediment in Ontario streams and lakes (excluding the Great Lakes).

It is divided into two sections: 1) references and abstracts and 2) a subject cross-reference index. Subjects cover a wide range of interests such as quality aspects of sediments (adsorbed contaminants and metals), erosional processes, sediment transport in rivers, sedimentation in reservoirs and lakes, and water quality aspects. In addition the subject list contains the names of the rivers and lakes.

## RESUME

Ce rapport est un catalogue de références concernant les sédiments dans les rivières et lacs de l'Ontario (excluant les Grand Lacs).

Il est divisé en deux sections: 1) références et résumés et 2) un index de renvois par sujet. Les sujets englobent une large gamme d'intérêts tels la qualité des sediments (contaminants et métaux adsorbés à la surface), les processus d'érosion, le transport de sédiments dans les rivières, la sédimentation dans les réservoirs et les lacs et la qualité des eaux. En plus, la liste de sujets contient les noms des rivières et lacs.

## INTRODUCTION

This report presents a compilation of reference material on subjects related to the quality, erosion, transportation and deposition of sediments in Ontario streams, rivers and lakes (including interconnecting channels but excluding the Great Lakes due to the large amount of studies existing).

The 392 references included in this bibliography cover a wide range of subject matter such as suspended sediment transport in rivers, reservoir and lake sedimentation, river morphology, erosion studies and sediment quality.

The report is organized as follows:

1. A sequentially numbered alphabetical listing of references by author. Information on author, title and source is provided. In addition, an abstract or summary is given, which is either copied directly from the reference or compiled by the authors of this report. A comment on data source is also included. Data sources are divided into two classes: 1) primary, which includes references presenting original data; and 2) secondary, papers presenting previously published data (a reference to the primary source is given).

2. A cross-reference index by subject index. On page 245 a cross-reference list is provided. References identified by number are grouped under titles such as aggradation and degradation, bet and bottom sediments, bedload, river morphology, methods and techniques, suspended sediment, and water quality. River and lake names are also listed.

While the authors believe that most of the major references have been included it is realized that this compilation is incomplete. The authors would appreciate receiving additional references.

# REFERENCES AND ABSTRACTS

1. AGRICULTURE CANADA, ONTARIO MINISTRY OF AGRICULTURE and FOOD AND ONTARIO MINISTRY OF THE ENVIRONMENT
1978: Agricultural Watershed Studies, Great Lakes Drainage Basin, Canada; Final Summary Report, Task Group C (Canadian Section), Activity 1, PLUARG, International Joint Commission, Windsor, 78 p.

ABSTRACT:

This report contains the results obtained by all of the projects conducted within the Canadian PLUARG Task C Agricultural Watershed study. The approach is presented along with summaries and discussion of data, and possible remedial measures for all the major water quality parameters are investigated. Extrapolation to unmonitored areas and remedial measures alternatives are discussed for total phosphorus and sediment.

The Agricultural Watershed Studies consisted of investigations into the relationships between agricultural land and water quality in the Great Lakes Basin. Monitoring of water quality and quantity at eleven small watersheds, representative of major agricultural regions of the Canadian Great Lakes Basin, was carried out for two years. Detailed studies on sediment, nutrients and heavy metals were carried out in some of the watersheds. All watersheds were characterized in detail.

In terms of the water quality parameters of greatest concern to PLUARG - total phosphorus and sediment - the higher the degree of intensive cultivation and/or the greater the area of fine-textured soils, the greater were the unit-area loads. These watershed characteristics accounted for most of the differences observed in the loads of total phosphorus and sediment among the study watersheds.

Consideration was given to remedial measures programs to reduce the contributions of pollutants from agricultural activities. Although several possible measures were identified, it is emphasized that localized variations in pollution sources, soil properties and landscapes, cropping systems and active pollutant-contributing areas make general application of remedial measures impracticable.

Monitoring and detailed studies were also carried out to determine the role of agricultural land as a source of other water quality parameters. It was concluded that applications of fertilizer and manure, and livestock operations adjacent to streams were contributing manuare to the observed level s of the dissolved fractions of phosphorus (ortho-P) and nitrogen ($NO^2$ + $NO^3$) in streams.

It was determined that agricultural activities were not influencing the quantities of heavy metals in streams, other than by way of increases in stream sediment loads that were naturally associated with the sediment.

Other observed non-agricultural influences on water quality in the agricultural watersheds were: the contribution of rural housing to dissolved phosphorus levels; the presence in streams of herbicides from spraying of highway rights-of-way and the almost constant presence of the industrial organic toxicant PCB, believed to be primarily the result of atmospheric deposition.

DATA:

Primary Source.

2. ALLAN, R.J.
1974: Metal Contents of Lake Sediment Cores from Established Mining Areas: An Interface of Exploration and Environmental Geochemistry; Geological Survey of Canada, Paper 74-1, Part b, p. 43-49.

ABSTRACT:

This report gives some results of cores taken at Red Lake, at lakes near Sudbury and Chibougamau. Detail is given for one specific metal per site: Ni near Sudbury, As at Red Lake and Cu at chibougamau.. Results show that in all three areas the lake bottom sediments reflect the effects of pollution.

DATA:

Primary Source.

3. ALLAN, R.J.
1979: Sediment-Related Fluvial Transmission of Contaminants: Some Advances by 1979; Scientific Series No. 107, Environment Canada, Inland Waters Directorate, Western and Northern Region, 24 p.

ABSTRACT:

Suspended sediment can be a major transport mechanism for nutrients and contaminants in drainage systems. Bottom sediment pollution has been extensively studied, but until recently suspended sediment has seldom been chemically analyzed. Sufficient suspended sediment could not be collected for detailed nutrient and contaminant analysis until the advent of land-based continuous flow centrifuges. This report describes the evolution of this area of investigation and the stage of development reached in Canada as of 1979. Problems of sampling and analytical requirements are discussed. Examples are included of the types of results being obtained by the main Canadian investigators. Relationships between suspended and bottom sediment chemistry are described. Interaction between those involved in sediment surveys for engineering purposes, water quality monitoring, and research into drainage system contaminant transmission is advocated. Such

interaction could rapidly extend existing knowledge in this area, critical to pollution control and environmental basin management.

DATA:

Secondary Source; refer to Ongley et al. (1981).

4. ALLAN, S.
1982: A Proposed Paleoflow Reconstruction Model of Irvine Creek, Elora, Ontario; Unpublished B.A. Thesis, Department of Geography, Wilfrid Laurier University, Waterloo, 67p.

ABSTRACT:

Models have been developed for various sediment formations with the purpose of illustrating and interpreting the processes controlling their genesis. This study proposes such a model which attempts to suggest the varying flow velocities and characteristics operating during the time of deposition of a bar. This Generalized Flow Model is derived from the analyses of particle size, shape and orientation data gathered form a longitudinal bar found in the Irvine Creek, Elora, Ontario.

DATA:

Primary Source.

5. ARMSTRONG, F.A.J. and HAMILTON, A.L.
1973: Pathways of Mercury in a Polluted Northwestern Ontario Lake; In: Trace Metals and Metal - Organic Interactions in Natural Waters, P.C. Singer, editor, Ann Arbor Science, p. 131-156.

ABSTRACT:

The surveys reported here are part of a continuing study of Clay lake and its biota and have been performed in order first to measure the quantity of mercury in the sediments and its distribution; second, to determine levels of mercury in invertebrates and small vertebrates in the contaminated ecosystem and to attempt to relate differences in mercury concentrations to the life histories of the organisms; and third, to identify organisms which might be suitable as indicators of mercury pollution. Most specimens were collected in Clay Lake itself but some attention was given to animals from other parts of the system.

DATA:

Primary Source.

6. AVADHANULA, M.R.
1976: Water Quality Studies, Fall Report; Task Group C (Canadian Section), ACTIVITIES 1,3 and 4, PLUARG, International Joint Commission, Windsor, 24p.

ABSTRACT:

This report presents the progress achieved to date through the Activities 1, 3 and 4 of the PLUARG Task C study. Results summarized in this report correspond to the main objective of "obtaining the data on the inputs of pollutants" from the different land-use areas in the Grand, Saugeen and Wilton Creek Basins in Ontario.

Among the eleven agricultural watersheds included in the PLUARG study, Hillman Creek and the Little Ausable River sites (Ag.-13 and Ag.-3) contained the highest levels of $NO_2$ + $NO_3$. The highest total phosphorus concentrations were found in the downstream outlets of North Creek and Big Creek (Ag.-10, Ag.-1). Total phosphorus showed significant correlations (r values greater than .8) with ion, TKN and turbidity, whereas inorganic nitrogen had poor correlation values with phosphorus. Great consistency was observed in the water-quality data over the study period (1974, 1975, spring 1976).

In general, the results of the investigations under PLUARG confirm results derived from the analyses of the historic Grand River water-quality data. Marked seasonal trends and monthly variations in some parameter concentrations were observed in these data. The PLUARG data for the Grand River Basin exhibited water-quality deterioration at downstream stations. The concentrations of important nutrients (phosphorus and nitrogen) increased from the middle of the Grand River Basin and remained high all along the downstream main channel to the outlet. In comparison the collected water-quality data suggest that the Saugeen River, Wilton Creek waters are free from any significant pollution.

Multivariate analyses of the 1975 PLUARG water quality was undertaken. The sampling stations with high levels of pollutant inputs were located on the Nith River tributary, below the urban areas and the downstream reach of the Grand River main channel. A better water quality was found to be present in the Saugeen River.

Based on current information, it is tentatively concluded that the urban and agricultural land-use activities are the main sources of pollutant contribution in the Grand River Basin.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

7. W.F. BAIRD and ASSOCIATES, COASTAL ENGINEERS LTD.
1984: A Preliminary Review of the Coastal Processes at Goderich, Ontario; Consulting Report to Public Works Canada, Ontario Region, 36p.

ABSTRACT:

This report is concerned with coastal processes (principally wave action and sand transport) that occur at Goderich and the changes to these processes that could occur following construction of a proposed facility. Three concepts for a new berth are investigated with regard to their possible influence on sediment deposition and the shoreline and river mouth to the north of the harbour.

DATA:

Secondary Source; refer to Water Survey of Canada data.

8. BASSEY, J.O.
1975: The Universal Soil-Loss Equation as a Means of Estimating Storm Suspended Sediment Load; Unpublished M.Sc. Thesis, School of Engineering, University of Guelph, 93p.

ABSTRACT:

The objective of this thesis is to investigate the usefulness of the Universal Soil-Loss Equation as a means of estimating storm suspended sediment load. The necessity for the study arose from the fact that the best way for estimating stream sediment load so far, in the semi and non-erodible channels, has been actual sediment concentration measurements at some control section of the stream. Sediment values for periods prior to establishment of such measurement stations and for those periods when no measurement could be done are lost. By using the Universal Soil-Loss Equation in this study, an attempt is made at producing a method that would finally use some of the commonly available hydrological, meteorological and agricultural data to expand the sediment data bank for streams for which these data are available.

In order to use the Universal Soil-Loss Equation for individual storm estimations, it was necessary to modify some of the factors to reflect shorter term variations than are customary with this equation. After such modifications, the Universal Soil-Loss Equation showed adequate scope for the realization of the study objective.

DATA:

Secondary Source; refer to Water Survey of Canada data.

9. BEAMISH, R.J. and VAN LOON, J.C.
1977: Precipitation Loading of Acid and Heavy Metals to a Small Acid Lake near Sudbury, Ontario; Journal of the Fisheries Research Board of Canada, Vol. 34, No. 5, p.649-658.

ABSTRACT:

The pH of Lumsden Lake was closely related to the measured amount of acid entering the lake from bulk precipitation. In 1972 it was estimated that an excess of 2135 kg of $H_2SO_4$ was added to the lake from the atmosphere. The predicted annual change in lake pH was from 5.2 to 4.8 and the actual measured change was from 5.2 to 4.7. In 1973 an estimated excess of 1271 kg of $H_2SO_4$ was added to the lake from the atmosphere. The predicted annual pH change was from 4.8 to 4.7 and there was no net change in the lake pH in 1973.

Lumsden Lake also had high concentrations of sulfate, manganese, zinc, and nickel in comparison with remote or "unpolluted" lakes. High concentrations of manganese and possible some zinc in the lake appeared to result from increased mobilization from the lake sediments or watershed or both as the pH decreased. Atmospheric fallout also contributed substantial quantities of nickel and copper to the watershed, some of which appeared to be retained in the lake water. The high concentrations of lead in the precipitation were not retained in the lake.

DATA:

Primary Source.

10. BENNETT, D.E.
1984: Sediment Delivery and Denudation Rates for Four Small Lake Erie Watersheds; Unpublished B.A. Thesis, Department of Geography, Wilfrid Laurier University, Waterloo, 75p.

ABSTRACT:

Four small Lake Erie watersheds were studied to determine their sediment delivery rates and the denudation rate for the region as a whole. Two of the creeks, Big and Big Otter, were gauged and two, Kettle and Catfish, were not.

The analyses involved the prediction of flow discharge for the ungauged streams using a discharge equation with area, slope, rainfall, and snowfall variables. Sediment discharge for these creeks was predicted from a regression equation developed from the published values for Big and Big Otter Creeks.

The results produced a regional denudation rate of 5.038cm/1000 years after land use and vegetation variations across the area were taken into consideration. This rate compared favorably with other values described in the literature.

DATA:

Secondary Source; refer to Water Survey of Canada data.

11. BERG, O.W., DIOSADY, P.L. and REES, G.A.V.
1974: PCB Contamination of the Aquatic Environment in Ontario; Report, Ontario Ministry of the Environment, Laboratory Branch, 19.

ABSTRACT:

Sporadic analyses of sampling from the aquatic environment have shown the PCB's are universal pollutants. Almost without exception the contaminant was of the Aroclor 1254 type. The approximate levels were as follows: effluents from sewage treatment plants up to 0.1 ppm, river sediments up to 0.6 ppm, fish up to 20 ppm and seagulls up to 1500 ppm in fatty tissues.

In order to gain more detailed information, a systematic large scale survey was undertaken. Four different types of aqueous systems were studied: an industrialized "impound system", an industrialized "dynamic system", a natural "impounded system", a natural "static" system and a natural "dynamic" system. Water, bottom sediments and fish were analyzed, and the data obtained is presented and discussed. The analytical techniques - separation of PCB's from other chlorinated materials and the determination of PCB's in terms of the fully chlorinated derivative-decachloro biphenyl are discussed as well.

DATA:

Primary Source.

12. BLACK, J.J.
1983: Field and Laboratory Studies of Environmental Carcinogenesis in Niagara River Fish; Journal of Great Lakes Research, Vol. 9, No. 2, p.326-334.

ABSTRACT:

Combined field and laboratory studies were carried out to assess the possible role of contaminated bottom sediments to neoplastic disease in fish from eastern Lake Erie and the upper Niagara River. Correlations between sediment polycyclic hydrocarbons, neoplasms in feral fish, and the induction of neoplasms in bullheads (Ictalurus nebulosus) by exposure to extracts of polluted sediment support the hypothesis that some fish neoplasms result from exposure to carcinogenic chemicals present in the fishes environment.

DATA:

Primary Source.

13. BODO, B.
1976: Loadings and Parameter-Flow Relationships; Unpublished Report, Task Group C (Canadian Section), Activities 1, 3 and 4, PLUARG, International Joint Commission, Windsor, 27p.

ABSTRACT:

The purpose of this study is to estimate quantitatively the pollutant input into the Great Lakes system and to relate these estimates to the various land-use practices being examined under PLUARG Task C studies. These estimates are ultimately intended to provide a basis for basin-wide extrapolation of flux estimates.

The relationships between parameter concentrations and streamflow, as well as parameter mass flux computation at approximately thirty PLUARG sites for the year 1975 have been summarized. Relationships between concentration and flow have been grouped into three general categories. Nutrients, metals and generally the particulate-associated parameters tend increases. The "mineral" (sodium, sulphate, chloride, magnesium, etc.) relationships with flow. Varying degrees of scatter characterize most relationships which were investigated.

Loading estimates suggest that marked increases in the rates of contaminant flux occur from upstream to downstream sites on the Grand River. Significant increases in pollutant loads are observed below the urban complex of Kitchener-Waterloo, Guelph and Cambridge. These pollutant levels are sustained below the urban complex down to the mouth pollutant contributor in the lower reaches of the Grand River. The Saugeen Basin is a comparatively less polluted watershed, showing flux rates comparable to the upper and middle reaches of the Grand River. The agricultural watersheds vary considerably in pollutant outputs reflecting differences in type and intensity of agricultural activity. Some of these watersheds appear to be significant contributors of various pollutants, primarily nutrients. Flux estimates were derived by the IJC recommended approach.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

14. BODO, B. and UNNY, T.E.
1983: Sampling Strategies for Mass-Discharge Estimation; Journal of Environmental Engineering, Vol. 109, No. 4, p. 812-829.

ABSTRACT:

Methodology derived from sampling theory is presented for the estimation of in-stream contaminant mass-discharge or load. The historical record is stratified into relatively homogeneous units

in order to approach normality in the subpopulations thereby reducing the inaccuracies introduced by the highly skewed populations. Within strata a ratio estimator is employed to estimate the load and variance of the subpopulations. Strata are also defined to maximize other forms of inaccuracy. Estimates for individual strata are combined to produce pooled estimates for the desired period of interest. With a prior data base, sampling theory is employed to devise sampling strategies designed to produce load estimates of a specified target precision in future studies. Case studies demonstrate the significance of flow events as the primary transport mechanism for suspended sediment and the need to sample such events intensively in order to achieve reliable load estimates. Small "flashy" streams require sampling of much greater intensity during events than larger rivers with attenuated response in order to produce load estimates of comparable precision.

DATA:

Secondary Source; refer to Water Survey of Canada and Ontario Ministry of the Environment data.

15. BONNER, R.F. and MERESZ, O.
1981: St. Clair River Organics Study. Identification and Quantitation of Organic Compounds; Report, Ontario Ministry of the Environment, Laboratory Services Branch, Organic Trace Contaminants Section, 219p.

ABSTRACT:

This report presents and discusses data on the organic compounds present in a variety of samples collected from the vicinity of the St. Clair River in 1977 and 1978. It forms part of a major study on this river system which was initiated following exploratory work in 1975/76 the results of which are, to an extent, also reported here.

Based on the findings and recognized limitations of this study, the following conclusions are advanced: 1) In spite of the large volumes of effluents and numbers of organic compounds entering the river daily, the water quality is remarkably good. Evidence for this conclusion is to be found in the "Water Quality Sample" results presented in Tables 41 to 57 (pages 77 to 94). 2) Based on present knowledge, the majority of sewers discharging to the St. Clair River appear to present a minimal risk, especially in view of the high rate of dilution. 3) chlorination of organic compounds does occur, as previously documented, although the compounds identified both in this study and by the routine monitoring work are all volatile - chloroform, dichlorobromomethane, dibromochloromethane and bromoform. Carbon tetrachloride does not appear to be produced by this mechanism. The questions of whether there are non-volatile compounds

produced and what the precursors are (see Appendix 3), remain to be answered. 4) With regard to the observation of PCB's in sediments, it was concluded that these compounds may have arisen from use of PCB-based hydraulic fluids in the past since none of the industries studied are connected with the manufacture or distribution of these compounds. 5) Studies of this type need to involve samples that can be collected and stored without significant changes in the concentration of organic compounds. For volatile organics, techniques to minimize headspace and exposure to air, as well as the use of preservatives, should be investigated.

DATA:

Primary Source.

16. BOYD, G.L.
1973: The Siltation Problem at the Maitland River Mouth, Goderich, Ontario: Preliminary Review; Proceedings of the Second Workshop on Great Lakes Coastal Erosion and Sedimentation, Burlington, October 27, 1978, p. 83-87.

ABSTRACT:

The frequent development of a sand bar across the Maitland River mouth at Goderich inhibits boating access. Depth soundings, grab samples, streamflow records, dredging information, and historical photography were used to examine the factors affecting the development of this sand bar. High spring river discharge flushes the material out of the river mouth, while during low river flow, waves and littoral drift reform the bar. This cycle pre-dated harbour modifications and is considered the prevailing factor in the development of the bar.

DATA:

Primary Source.

17. BRAUN, H.E. and FRANK, R.
1980: Organochlorine and Organophosphorus Insecticides: Their Use in Eleven Agricultural Watersheds and Their Loss to Stream Waters in Southern Ontario, Canada, 1975-1977; Science of the Total Environment, Vol. 15, No. 2, p. 169-192

ABSTRACT:

As part of a comprehensive study of the effects of agricultural land use activities on the quality of water entering the Great Lakes, 949 stream water samples from 11 agricultural watersheds in southern Ontario were collected in 1975-1977 and analyzed for organochlorine and organophosphorus insecticide residues which

were currently in use in those watersheds. Detectable residues of chlordane, heptachlor epoxide, and endosulfan were found in 1.6, 6.0, and 19.3% of samples, respectively. Over 50% of the total organochlorine insecticides were found to be transported in the January-to-April periods corresponding to spring thaws, low ground cover, and high suspended solids in the water. Unit area loadings ranged from 0 to 4.5 mg/ha/yr for chlordane plus heptachlor epoxide and 0 to 89.9 mg/ha/yr for endousulfan. Water quality objectives proposed by the International Joint Commission were exceeded in 4% of samples by heptachlor epoxide, and 14% of samples by endosulfan.

Sixteen organophosphorus insecticides were known to be used in the watersheds but only chlorpyrifos, diazinon, ethion, and malathion were detected. Chlorpyrifos was present in only three samples, ethion in two, and malathion in four; 87 samples were found to contain diazinon but 4 of these were identified as orginating from an indoor (non land use) activity in one watershed. All field losses of organophosphorus insecticides occured in the May-August period correlating with the season of application. Proposed I.J.C. water quality objectives were exceeded in one sample where diazinon was used in land activities and in 77 samples as the result of diazinon being used in an indoor activity. No other organophosphorus insecticides were found which exceeded the proposed water quality objectives.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data and Coote et al. (1978).

18. BROOKS, G.R.
1985: Current, Erosional and Depositional Patterns at a River Confluence and Bend in the Nottawasaga River, Angus, Ontario; Unpublished M.A. Thesis, Department of Geography, Wilfred Laurier University, 138p.

ABSTRACT:

At a bend and confluence of the Nottawasaga River, sixty-four measurements of flow velocities were recorded at points along vertical profiles regularly spaced across a series of cross-sections. From the summarization of the data into a "three-dimensional" diagram, the current velocity patterns in the river reach were evident.

As observed at low discharge levels, the low speeds and directional uniformity of the flow in the Nottawasaga River entering the study reach suggests that the observed asymmetrical channel was a remnant of higher discharge levels. On the other hand, in the Pine River prior to entrance into the confluence, channel morphology was being influenced by much higher flow speeds

in combination with two cells of contra-rotating helicoidal flow. Active dunes and ripples were observed migrating along the asymmetrically shaped channel bottom. The erosional and depositional pattern of the tributary suggest that the Pine River mouth was slowly migrating upstream.

The fusion of the waters at the confluence resulted in very complex flow patterns. In the waters entering from the tributary, the presence of a helicoidal flow cell appeared to be causing a large bar to build along the bank immediately downstream from the Pine River mouth. Across the channel, the deflection of the Nottawasaga River flow was causing erosion of the opposite bank.

Downstream at the riffle area, flow in the Nottawasaga River accelerated as channel morphology became almost symmetrical. Around the bend, the development of a high speed filament and helicoidal flow cell were reflected by the asymmetrical channel and the erosional and depositional pattern along the banks. A large eroded area in the bank suggested that a proximal reverse circulation observed in the flow pattern along the outside of the channel was capable of causing erosion during high discharge levels. The overall velocity pattern observed at the bed became much less intense as flow entered a deep pool that was situated in the downstream section of the study reach.

Paleocurrent measurements of ripple marks on the point bar at the bend and a small "side" bars immediately downstream, gave an indication of flow patterns ocurring along the inner bank of the river at high discharge levels. These measurements showed that a large reverse circulation exists along the inner bank causing scouring of the downstream end of the point bar.

Excavations into the slumped area opposite the point bar revealed numerous sedimentary structures. Amongst these structures was evidence of point bar accretion, upstream migration of the tributary, a channel cut-off, and vertical accretion deposits on the floodplain.

DATA:

Primary Source.

19. BROWN, S.R., DALEY, R.J. and McNEELY, R.N.
1977: Composition and Stratigraphy of the Fossil Phobin Derivatives of Little Round Lake, Ontario; Limnology and Oceanography, Vol. 22, No. 2, p. 336-348.

ABSTRACT:

The chlorophyll derivatives from the sediment of meromictic Little Round Lake, Ontario, have been analyzed by artifact-free paper chromatography. Sixteen native and allomerized a and b

chlorophylls, chlorophyllides, pheophytins, and pheophorbides, together with bacteriopheophytin a and one unknown phorbin, were isolated from the core. No chlorophyll c derivatives were found. An average of 52% of the phorbins were devoid of Mg, 19% were allomerized, and 47% had lost the phytol group. Unaltered native chlorophyll b occurred in much higher proportions (22%) than chlorophyll a (0.3%), indicating that the b phorbins are more resistant than the a pigments to diagenesis. Continuous changes in derivative proportions with depth were not apparent; hence, little phorbin diagenesis occurred after burial in the sediment. The complexity of the profiles from this one lake suggests that using chlorophyll derivatives as paleolimnological indicators will be difficult.

DATA:

Primary Source.

20. BRUNSKILL, G.J., POVOLEDO, D., GRAHAM, B.W. and STAINTON, M.P.
1971: Chemistry of Surface Sediments of Sixteen Lakes in the Experimental Lakes Area, Northwestern Ontario; Journal of the Fisheries Research Board of Canada, Vol. 28, No. 2, p. 277-294.

ABSTRACT:

This paper contains some descriptive chemical data on bedrock, soils, and profundal lake sediments of the Experimental Lakes Area (ELA). The acid granodiorite bedrock and the plagioclase-K-feldspar-quartz glacial drift of the region exhibit low rates of chemical weathering. Terrestrial vegetation, soil organic matter, and the fine fraction of the glacial drift are concentrated in the lake sediments. The major minerals of the lake sediments are quartz, plagioclase, K-feldspar, illite, chlorite, kaolinite. Loss on ignition for the lake sediment samples varies from 18 to 3.5% dry weight, and total phosphorus from 0.1 to 0.3% dry weight. These surficial lake sediment samples are 88-96% water, and concentrations of major ions in sediment interstitial water are 1.5-5 times the concentration of major ions in lake water.

DATA:

Primary Source.

21. BUKATA, R.P. and BOBBA, A.G.
1983: Determination of Diffusion Coefficients Associated with the Transport of $^{210}$Pb Radionuclides in Lake Bed Sediments; Environmental Geology, Vol.5, No. 3, p. 133-141.

ABSTRACT:

An interative least-squares optimization technique is utilized in conjunction with a one-dimensional representation of the mass

transport equation to generate theoretical $^{210}Pb$ concentration/depth profiles beneath the water-sediment interface that are best-fit approximations to directly measured $^{210}Pb$ concentration/depth profiles at various locations within the Great Lakes system. The outputs of such an optimization analyses are the diffusion coefficients $D_M$ (molecular) and $D_B$ (bioturbation) associated with the transport of $^{210}Pb$ radionuclides in lake bed sediments.

For all stations studied, the estimated values of $D_B$ are consistently larger than the estimated values of $D_M$, emphasizing the importance of accounting for the effects of bioturbation in the modelling of contaminant transport through lake bed sediments.

DATA:

Secondary Source; refer to Durham and Joshi (1981).

22. BUMA, P.G.
1971: Channel Morphology Below Deer Creek Dam; Unpublished B. Sc, Thesis, Department of Geography, University of Western Ontario, London, 73p.

ABSTRACT:

The purpose of this paper is to characterize the morphology of a stream reach by examining the form of the channel, its bed and bank material and the possible change of these two downstream. The stream reach is located in Southwestern Ontario, below Deer Creek dam.

It is found from the application of a multivariate technique to various hydraulic variables, that in most cases, interaction between the variables corresponds to the relationships established in the literature. By examining the distribution of particle size for straight and meander sections and relating it to velocity distribution and channel profile, it is found that there are basic differences in the channel morphology between straight and meandering sections. Downstream relationships between channel fow and resistance lead to the conclusion that Deer Creek is dynamic, capable of increasing its cross-sectional area in width and depth.

By establishing the present channel morphology relationships at Deer Creek, it is hoped that this paper will provide a base from which the channel morphological response to the construction of Deer Creek dam can be determined. Several recommendations are volunteered to aid such an analyses.

DATA:

Primary Source.

23. BUMA, P.G. and DAY, J.C.
1977: Channel Morphology Below Reservoir Storage Projects; Environmental Conservation, Vol. 4, No. 4, p.279-284.

ABSTRACT:

Reservoir storage projects are known to alter significantly the environmental settings in which they are established. This study documents stream - channel changes over a five-year period following reservoir completion at eight cross-sections on the main stream below a dam and on one tributary. The authors have explored a method of isolating particular plant communities from the vegetation complex downstream of the dam. Extraction of most of the sediment load by the new reservoir led to increased erosion of the stream channel below the dam. However, it is not always predictable whether the increased erosive power of released clearwater will induce the ongoing channel to erode its bed, widen its section, or cause the bed to move laterally. Nearly all of the nine Deer creek study sections experienced one of these changes over the study period.

DATA:

Primary Source.

24. BURDEN, E.T.
1978: Pollen and Algal Assemblages in Cored Sediments from Gignac Lake and Second Lake (Simcoe Co., Ontario): Relationships with Lacustrine Facies, Geochemistry and Vegetation; Unpublished M. Sc. Thesis, Department of Geology, University of Toronto, Toronto, 178p.

ABSTRACT:

Relationships between lake sediment, forest cover and vegetation changes through time are examined with a transect of four short cores, extending from the shallow water littoral region to the deeper basin. These cores were collected from both Second Lake and Gignac Lake (Simcoe Co., Ontario). Palynomorphs from the cores and geochemical determinations (percent water content, weight loss on ignition, x-ray diffraction and elemental analyses by neutron activation with a SLOWPOKE II nuclear reactor) are used to correlate sedimentation with vegetation change.

Three pollen assemblage zones are recognised. The lowest zone IIIc is dominated by Fagus, Acer and Tsuga pollen. The basal date of this zone has not been determined but the top date is about 1475 A.D., correlating with the start of local Indian agriculture and a blobal cooling trend. Pollen zone IIId contains abundant Pinus, Betula and Quercus pollen. In the lower part of this zone, a large herb component of Pteridium, Gramineae and Zea mays pollen is present in Gignac Lake. This indicates Indian forest

clearance with agriculture that lasted until 1650. Forest clearance was followed by succession of a closed canopy forest with more birch, oak and pine. At about 1850 Ambrosia pollen increases in southern Ontario and marks the beginning of pollen zone IV. At about 1875, the land surrounding Second Lake and Gignac Lake was logged and agriculture initiated around Second Lake. Pinus, Quercus and Betula pollen decline and Ambrosia and other herb taxa increase in the uppermost sediments.

Lacustrine algal assemblages and sediment geochemistry changes occur concomitantly with chagnes in the upland vegetation. Pediastrum and dinoflagellate cyst Type D increase when the upland areas are cleared. When a closed canopy forest covers the upland areas and sediment erosion is slight, Pediastrum and Type D cysts are not common. Instead, other dinoflagellate cysts (Types B and F) may dominate. However, for these cysts there is a more complicated relationship involving changes in both temperature and depth.

Chemical changes in these lakes during the last 600 years are related to inferred changes in lake depth, development of dimictic circulation, a simi-stable hypolimnion and the increase in chemical and mineral influx from exposed upland soils. Changes in the influx of Ca, Mn (and to a lesser extent Mg and Ba) into sediments may relate to the development of a hypolimnion. Low pH, high $CO_2$ partial pressures and reducing conditions develop near the bottom preventing accumulation of Ca and Mn precipitates because of semi-stable conditions during the summer. These conditions favour organic sediment accumulation. Uranium and some halogens and metallic elements may be adsorbed on organic material or form organic complexes. Increases in Na, Al, Ti and Dy influxes correlate with palynologic assemblages that indicate vegetation disturbance. X-ray diffraction and microfossil residue analyses show plagioclase, amphibole, illite and garnet in these sediments. These minerals contain some of the elements that increase with forest disturbance. Weight loss on ignition in organic sediments from Gignac Lake substantiates greater clastic mineral deposition during forest disturbance.

Algal distribution is apparently controlled by temperature, depth and chemical changes identified through elemental analyses using neutron activation. Chemical and temperature changes during the past 600 years are the major controls on algal assemblages, although identification of a specific limiting element is not possible.

DATA:

Primary Source.

25. BURDEN, E.T., and McANDREWS, J.H. and NORRIS, G.
1986: Palynology of Indian and European Forest Clearance and farming in Lake Sediment Cores from Awenda Provincial Park, Ontario; Canadian Journal of Earth Sciences, Vol. 23, No.1, p.43-54.

ABSTRACT:

Palynologic analyses of four short cores collected along shallow-to deep-water transects in Second and Gignac lakes indicate two periods of forest clearance for farming. The first deforestation was by Huron Indians between A.D. 1450 and 1650, when a maple (Acer), beech (Fagus), and oak (Quercus) forest was cleared and corn (Zea) planted. This disturbance is identified by decreased tree pollen and increased Pteridium, Artemisia, and other herbs and is confirmed by Zea pollen in Gignac Lake. From 1650 to 1875 there was a forest succession to oak, birch (Betula), and pine (Pinus). Following this recovery European loggers and farmers cleared this forest and attempted farming. Besides a reduction in tree pollen, a product of this deforestation includes the pollen of weedy Ambrosia, Gramineae, and introduced European Rumex and Plantago. During the last 25 years an increase in tree pollen indicates local forest recovery consistent with present land use.

By relating upland vegetation successions to lacustrine algal assemblage changes, probable ecological controls on algae during the last 600 years are identified. Peridinium willei Huitfeldt-Kaas and Pediastrum respond to changes induced by forest clearance and agriculture. Aquadulcum awendae n. sp. and Peridinium wisconsinense Eddy prefer less alkaline water.

Variations in palynomorph influx are related to basin morphology and water circulation. Gignac Lake, a steep sided and relatively deep lake, directs palynomorphs from shallow marginal banks to the deeper basin, whereas Second Lake, with a gently sloping shallow lake bottom, preferentially accumulates palynomorphs close to shore.

DATA:

Secondary Source; refer to Burden (1978).

26. BURDEN, E.T., NORRIS, G. and McANDREWS, J.H.
1986: Geochemical indicators in Lake Sediment in Upland erosion Caused by Indian and European Farming, Awenda Provincial Park, Ontario; Canadian Journal of Earth Sciences, Vol. 23, No. 1, p. 55-65.

ABSTRACT:

Neutron-activation analysis, loss on ignition (LOI), and X-ray diffraction eight cores collected in Second and Gignac lakes are correlated with historic and palynologic records to identify elements linked to erosion from deforestation and farming.

Forest disturbance and farming are identified in cores of organic detritus sediment (gyttja) by decreased LOI and increased Na, Mg, Ba, Al, Ti, and Dy. LOI is not suitable for identifying forest disturbances in carbonate sediments. From neutron-activation analysis of carbonate mud only Na, Al, and Dy indicate erosion.

Elements linked to the quantity of organic matter in sediments include U, V, and Cl, whereas Mn and I in surface sediments presumably correspond with variations in the oxidation potential and plant productivity, respectively.

Sedimentation patterns related to basin morphology. In Gignac Lake the basin is steep sided and relatively deep. Clastic detritus entering the lake is carried over the shallow, nearshore carbonate bank into deeper water. In Second Lake the basin is shallow and gently sloping. Minerals eroded from onshore are more equally distributed in this basin. In Second Lake the most rapid sedimentation is nearshore where submerged aquatic macrophytes produce and trap carbonate mud. In Gignac Lake the top of the shallow carbonate bank has few aquatic macrophytes; lime mud formed on the bank is washed into deep water offshore, where it dissolves.

DATA:

Secondary Source; refer to Burden (1978).

27. BYNOE, M.C.
1979: Spatial and Temporal Trends in the Fluvial Transport of Sediment-Associated Heavy Metals in Wilton Creek, Southeastern Ontario; Unpublished M.Sc. Thesis, Department of Geography, Queen's University, Kingston, 206p.

ABSTRACT:

In view of the importance of nonpoint source contributions of sediment-related contaminants to the degradation of water quality in the Great Lakes, knowledge is needed of the spatial and temporal fluxes of these contaminants. Investigation of the fluxes from watersheds under a variety of land uses is essential to the development of cost-effective land use and management and water quality sampling strategies aimed at reducing contaminant loadings to the Lakes.

Towards this research goal, this study has attempted to investigate the fluxes of sediment-related heavy metals from Wilton Creek, a small rural catchment under improved pasture land use in southeastern Ontario. Using a bulk sampling continuous-flow centrifuge on-site, suspended sediments were recovered from the creek during periods of high discharge - storm events for one open water year. Bed/bank and soil samples were obtained throughout the watershed to establish background

concentrations of metals and major elements. Cladophora glomerata, a filamentous green algae dominant in the creek was sampled for biomass and heavy metal loading estimations in the fall of 1977 and the spring of 1978.

Suspended sediment, bed/bank and soil samples were analyzed by A.A.S. for total ($HNO_3$-HCl digestion) and cold extractable (DTPA extractable) concentrations of Ni, Cu, Zn, Cd, Pb, Co, and Mn. The concentrations of ten major elements were determined for these samples by X-ray Fluorescence. Total heavy metal concentrations in Cladophora were determined by A.A.S. using $HNO_3$-HCl digestion.

Statistical analysis of heavy metal concentrations demonstrated significant differences of sediment-associated metal concentrations with season, the concentrations being the highest in the summer and lowest in the spring. Linear regression of total heavy metal and major element contents against organic matter and particle size contents (determined in concurrent investigations) indicated inorganic associations of the metals in spring samples in contrast to varied and undetermined particulate/metal associations in summer and fall samples. Despite elevated heavy metal values in the summer suspended sediment samples, the magnitude of heavy metal fluxes is greatest in the spring and the fall. Such information should be considered to optimize sampling strategies for monitoring of sediment-related heavy metals.

DATA:

Primary Source.

28. CANADA - ONTARIO REVIEW BOARD
1980: Environmental Baseline Report of the Niagara River, Joint Report, Environment Canada and Ontario Ministry of the Environment, 31p.

ABSTRACT:

This report summarizes Canadian data on water, suspended sediment, bottom sediment and biota collected in the Niagara River between 1975 and 1979. Over the period 1975-1979, yearly average water quality conditions in the Niagara River met the objectives of the 1978 Canada/U.S. Great Lakes Water Quality Agreement and those of the Ontario Ministry of the Environment. Analysis of samples of raw water taken from the Niagara-on-the-Lake and Niagara Falls (Ontario) water treatment plants and from the Niagara River adjacent to the town of Fort Erie met federal and provincial criteria for acceptable drinking water. The Niagara River Basin is a continuous source of organic compounds and metals associated with suspended sediments to Lake Ontario. PCBs and some pesticides enter the river downstream from Grand Island, New York, as well as from the Love Canal and Buffalo River area in New York. Results of analysis of suspended sediment samples indicated

instances of high concentrations of PCBs and Hexachlorobenzenes (HCBs) 3 to 5 times the mean values detected. It is suspected that they resulted from intermittent direct effluent discharges of these substances to the river. All bottom sediment samples from the lower Niagara River and 83% of the samples from the upper Niagara River had concentrations of PCBs exceeding 50 parts per billion, which is Environment Ontario's dredge spoil criterion. Since monitoring of fish began in 1975 at Niagara-on-the-Lake, PCB residues have declined 78%, mercury residues by 33%, and total DDT residues by 89%. The Niagara River is a continuing source of numerous metals and organic compounds, including mercury, PCBs, mirex and DDT, to Lake Ontario. While surveillance efforts of river water quality have been increased, industrial and municipal effluent monitoring with respect to synthetic organics and other potentially toxic substances should be strengthened.

DATA:

Primary Source.

29. CANADA - ONTARIO REVIEW BOARD
1981: Environmental Baseline Report of the Niagara River: November 1981 Update; Joint Report, Environment Canada and Ontario Ministry of the Environment, 31p.

ABSTRACT:

In June 1980, the Canada - Ontario Review Board released the Environmental Baseline Report of the Niagara River. The report focussed on water quality problems resulting from inadequate control of toxic substances as evidenced by their presence in the Niagara River and Lake Ontario. Since publication of that report, additional analyses on 1979 and 1980 studies have been completed and the preliminary results of more recent (1981) studies have become available. This additional information is presented in the present report of the Canada - Ontario Review Board. This summary highlights the more significant findings and conclusions of the 1981 update relative to the June, 1980 findings.

DATA:

Primary Source; also refer to Canada - Ontario Review Board (1980).

30. CANADA - ONTARIO STEERING COMMITTEE
1983: Mercury Pollution in the Wabigoon-English River System of Northwestern Ontario, and Possible Remedial Measures; Summary of the Technical Report, Government of Canada and Government of Ontario, Vol.1, 18p.

ABSTRACT:

This Summary Report has been prepared by the Canada - Ontario Steering Committee of three federal and three provincial staff, established to investigate mercury pollution in the Wabigoon-English River system of northwestern Ontario. The report highlights the Problem, Conclusions and Recommendations associated with the assessment of mercury pollution in the system and with the evaluation of methods which might be employed to accelerate natural recovery of the system. The material has been extracted largely from the companion Technical Report which is a detailed compilation of the results of investigations conducted in the field by individual researchers. Some sections of the Technical Report have already appeared in scientific journals. Although they have been derived from a review of the Technical Report, the Conclusions and Recommendations are those of the Steering Committee and do not necessarily represent a consensus of the authors of the Technical Report.

DATA:

Secondary Source; refer to Canada - Ontario Steering Committee (1983b).

31. CANADA - ONTARIO STEERING COMMITTEE
1983b: Mercury Pollution in the Wabigoon-English River System of Northwestern Ontario, and Possible Remedial Measures; Technical Report, Government of Canada and Government of Ontario, Vol. 2, 538p.

ABSTRACT:

This two-volume report contains the results of investigations of mercury pollution in the Wabigoon-English River system of northwestern Ontario and the evaluation of methods which might be employed to accelerate natural recovery of the system. Volume 1 is a summary, also available in french, which highlights the problem, conclusions of the research and monitoring studies, and recommendations agreed to by the steering committee which managed this joint Canada-Ontario study. Volume 2 contains eleven reports. One report gives a description of the study area, mercury in sediment, total and methylmercury in water, mercury in biota, relationship between mercury in water, sediment and biota, effects of discharges from great lakes forest products on mercury in the receiving stream, and remedial measures including a semi-quantitative model for assessing the usefulness of various

amelioration schemes. Two reports are presented on mercury pollution in the system. Eight reports are included on factors controlling mercury bioaccumulation in aquatic ecosystems with emphasis on mercury-selenium interactions, their effects on fish, selenium as a mercury ameliorating agent and selenite toxicity. Each report includes method, results, discussion and references.

DATA:

Primary source.

32. CAREY, J.H., FOX, M.E., BROWNLEE, B.G., METCALFE, J.L., MASON, P.D. and YEREX, W.H. 1983: The Fate and Effects of Contaminants in Canagagigue Creek; Scientific Series No. 135, Environment Canada, Inland Waters Directorate, National Water Research Institute, 37p.

ABSTRACT:

A study of the biological community of Canagagigue Creek was conducted by seasonally collecting fish and benthos from six sites between the Woolwich Reservoir and the confluence with the Grand River, Ontario. Trends of species abundance and diversity are discussed, and a diversity index has been calculated for the benthic fauna at each site. Fish and benthos both demonstrated a clear pattern of markedly decreased abundance and species diversity below the site of contaminant inflow relative to the upstream sites. At the farthest downstream site, virtually complete recovery from the environmental stress was demonstrated by high abundance and species diversity.

A survey of synthetic organic contaminants was also conducted. Chlorophenols, benzothiazoles and lindane were all present at elevated levels downstream from Elmira when compared with their concentrations at the upstream sites. A series of unidentified acidic compounds was also discovered to have been formed in the Woolwich/Elmira Water Pollution Control Plant from unidentified precursors. All of the observed contaminants decreased significantly in concentration with distance downstream. The chlorophenols were found to have accumulated in benthos and fish. This study will form the basis of an in-depth examination of the pathways of accumulation and degradation of these synthetic organic contaminants in the stream.

DATA:

Primary Source; also refer to Ontario Ministry of the Environment data.

33. CARIGNAN, R. and NRIAGU, J.O.
1985: Trace Metal Deposition and Mobility in the Sediments of Two Lakes near Sudbury, Ontario; Geochemica et Cosmochimica Acta, Vol. 49, No. 8, p. 1753-1764.

ABSTRACT:

The accumulation and mobility of Fe, Mn, Al, Cu, Ni and Pb in the sediments of two lakes (Clearwater, pH 4.5; and McFarlane, pH 7.5) near Sudbury, Ontario have been investigated. The Al, Cu and Ni concentrations are expectedly relatively high in the overlying waters of Clearwater Lake and much lower for Al and Cu in McFarlane Lake. The low trace metal concentrations found in the anoxic porewaters of Clearwater Lake could be explained by a sharp increase in porewater pH concomitant with $SO_4$ reduction and $H_2S$ production within the first 1-2 cm of the sediments, which has conceivably led to the precipitation of mineral phases such as $AL(OH)_3$, NiS and CuS. In both lakes, Fe concentrations in anoxic porewaters appear to be controlled by FeS and/or $FeCO_3$ formation. Solubility calculations also indicate $MnCO_3$ precipitation in McFarlane Lake. In Clearwater Lake, however, both porewater and total Mn were relatively low, a possible result of the continuous loss of Mn(II) through the acidic interface. It is suggested that upwardly decreasing total Mn profiles resulting from the removal of Mn from the top sediment layers under acidic conditions may constitute a reliable sympton of recent lake acidification.

The downward diffusion of Al, Cu and Ni from the overlying water to the sediments has been estimated from their concentration gradients at the interface and compared to their total accumulation rates in the sediments. In both lakes the diffusion of Al is negligible compared to its accumulation rate. However, diffusion accounts for 24-52% of the accumulation of Cu in the sediments of Clearwater Lake, but appears negligible in McFarlane Lake. The downward diffusive flux of Ni is important and may explain 76-161% of the estimated Ni accumulation rate in Clearwater Lake, and 59% in McFarlane Lake. The porewater Cu and Ni profiles suggest that the subsurface sedimentary trace metal peaks observed in Clearwater Lake (as in other acid lakes) may not be caused by sediment leaching or by a recent reduction in sedimentation but may have a diagenetic origin instead. Diffusion to the sediments thus appears to be an important and previously overlooked trace metal deposition mechanism, particulary in acid lakes.

DATA:

Primary Source.

34. CBCL LTD and Associates
1981: Mercury Reduction in Sediments; Report to Environment Canada, 11p.

ABSTRACT:

This report summarizes all relevant data resulting from research done by CBCL Limited into the relationship between mercury and various types of sediments, methods of material handling, chemical and organic treatment options, operational criteria and conceptual process plant design. The object of the program was to evaluate the viability of removing mercury from contaminated sediments. A laboratory analyses was undertaken on samples of contaminated material collected from affected areas in Dryden, Ontario, Noranda, Quebec, and Pinchi Lake, British Columbia. This examination indicated that the type of contaminated sediments varied. It was concluded that dewatering would be an appropriate primary process returning the bulk of the water to its source before any form of sediment cleaning. Various dewatering methods were investigated, but no method was found to accommodate the multivarious fractions of material. It was noted that mercury could be easily vaporized off the sediments into a gas flow at a low temperature and then collected by amalgamation using a variety of noble and common metals. The mercury vapour could be economically collected from a hot gas stream by using activated carbon as a sub-strate. A complex mechanical dewatering system designed to deal with the wide spectrum of mercury laden sediment types is described. The complete processing plant is proposed as a mobile facility. A unique sediment collecting dredge has been designed to recover the sediments with a low water content. With the system described, contaminated areas can be restored to within acceptable levels of toxicity, with minimum disruption or environmental damage to the ecosystem. The recommended action resulting from this study is that a prototype system and processing plant be designed, constructed and positioned for trials and operational refinement at the upstream end of the contaminated area in the Wabigoon River at Dryden, Ontario. A literature review was undertaken as part of this study and is presented in a separate volume.

DATA:

Primary Source.

35. CECILE, C.P.
1983: Oshawa Second Marsh Baseline Study, Final Report, Documentation, Integration of Ecological Data; Environment Canada, 158p.

ABSTRACT:

Environmental studies by Environment Canada under the federal baseline studies programme were initiated as a result of increased public interest and concern in Oshawa Second March. These studies

provide the necessary information base to facilitate the management of the marsh in an environmentally sound manner. The 117 hectare Second Marsh study area located within the city of Oshawa, includes a lakeside marsh and woodland. Components studies included watershed erosion and sediment transport, marsh soil and sediment quality and quantity, water quality and quantity, shoreline processes, vegetation, and wildlife. Very high loads of sediment eroded from the watershed are being deposited in the marsh. The bottom sediments are contaminated with heavy metals such as nickel and zinc. Water quality has been improving. While second marsh historically was an important migratory waterfowl staging areas, it currently supports a much reduced duck population. The marsh still hosts a high diversity of migrating and breeding birds. Impacts and changes sustained by the marsh include a high rate of sediment deposition, increased pollutant loading, isolation of the marsh from other natural areas, and large numbers of disruptive carp. In addition, dyking of the previous western outlet resulted in the formation of the eastern outlet which led to other changes in the marsh. Sedimentation within Second Marsh is currently the most serious threat to its existence and value as a wildlife habitat.

DATA:

Secondary Source; refer to Durham and Joshi (1981) and Smith, B.D. (1982).

36. CHAMNEY, L.G.
1979: Historical and Contemporary Sedimentation in Peters Lake, Southeastern Ontario; Unpublished M. Sc. Thesis, Department of Geography, Queen's University, Kingston, 240p.

ABSTRACT:

An examination of lake sediments and water in Peters Lake, a small (21 ha), shallow lake located in the document historical patterns of sedimentation in the gasin, and to characterize historical and contemporary controls on lake sedimentation and sediment transmission through the Millhaven Creek watershed.

Sediment cores were retrieved from Peters Lake and geochemically examined, and surface waters of the middle basin of Millhaven Creek surveyed for several water quality parameters. Geochemical fluctuations of water content, organic matter, particle size, carbon, pH, and major and trace elements with depth in the sediments provided a temporal and spatial documentation of changes in watershed sedimentary processes.

Peters Lake has formed in a broad, preglacial fault valley, in which surface waters are dominated by a series of lakes, drowned river channels, and marshes. Peters Lake provides temporary storage of Millhaven Creek flows, with lake water movements being generated primarily by wind currents and Millhaven Creek inflows.

During the water quality sampling season, surface waters were characterized by relatively low summer flushing rates, high temperature and pH, high D.O. and TDS concentrations, low suspended solid concentrations, and high concentrations of Ca and Mg.

Core sediment geochemical profiles and echo-sounding data identified two sedimentary strata lying above glacial deposits: upper, nutrient-rich, dark-coloured sediments (termed allogenic), and lower, light-coloured, calcareous deposits (termed marl). The "threshold" boundary between the two sediment types marked a decline in fibrous macro-organics, a colour change from dark to light, and the initiation of gastropod (Amnicola, Planorbis) and pelecypod (Posidium) shells. Depth to the threshold from the sediment-water interface differed between proximal (84 cm) and central sedimentation rates in the proximal zone.

Marl deposits in the lake resulted from precipitation of $CaCO_3$ carried in groundwater flows which percolated through highly calcareous bedrock and surficial materials in the basin. Depletion of the allogenic carbonate reservoir by stabilization of the basin's leaching zone resulted in increased groundwater transport of nutrients and metals, and thus in the termination of marl formation and the deposition of nutrient-rich sediments. The colour change and shell extinction boundary marks a threshold in processes responsible for marl deposition, with the influence of carbonates on sediment geochemistry below the threshold being replaced by a dominance of weathered alumino-silicate products above the threshold.

Cultural impacts on lake sedimentation began circa 1800 A.D. and, based on geochemical fluxes, are recorded at depths of 40 cm in proximal sediments and 16 cm in central sediments, giving respective postcultural sedimentation rates of 2.2 mm $y^{-1}$ and 0.9 mm $y^{-1}$.

Peters Lake and the marshy Millhaven Creek basin upstream of Odessa exert both long-term and short-term regulatory controls on fluxes of water and sediments, and their associated transport of nutrients and contaminants, in the Millhaven Creek watershed.

DATA:

Primary Source.

37. CHAN, C.H., LAU, Y.L. and OLIVER, B.G.
1986: Measured and Modelled Chlorinated Contaminant Distributions in St. Clair River Water; Water Pollution Research Journal of Canada, Vol. 21, No. 3, p. 332-343.

ABSTRACT:

The concentration distribution of hexachlorobutadiene (HCBD), pentachlorobenzene (QCB), hexachlorobenzene (HCB) and

octachlorostyrene (OCS) in water samples from transects across the upper and lower St. Clair River and the upper Detroit River were determined on four occasions in 1985. The data show a plume of these contaminants from the Sarnia Industrial area. The fluxes and concentration profiles of the contaminants at Port Lambton have been modelled successfully using a simple transverse mixing model. A study on the chemical partitioning between the "dissolved" and "suspended sediment" phases shows that an important contaminant fraction is carried in the river by the suspended solids, particulary for lipophilic compounds such as HCB and OCS.

DATA:

Primary Source.

38. CHATARPAUL, L. and ROBINSON, J.B.
1979: Nitrogen Transformations in Stream Sediments: $^{15}N$ Studies; In: Methodology for Biomass Determinations and Microbial Activities in Sediments, C.D. LITCHFIELD and P.L. SEYFRIED, Editors, American Society for Testing and Materials, Special Technical Publication, No. 673, p. 119-127.

ABSTRACT:

Laboratory studies were carried out on sediment samples taken from a perennial stream draining an agronomic watershed. Columns of sediment were placed in acrylic plastic tubes, overlain with isotopically labeled nitrate, and incubated at 15°C. An optical emission spectrometer was used to determine the excess $^{15}N$ in each of the $NO_3$, $NH_4$, and organic nitrogen fractions at various times. It was concluded that the previously observed loss of nitrate from from aerated water overlying stream sediment was indeed the result of denitrification. It was also established that nitrification and denitrification were proceeding simultaneously and that less than 2 percent of the added labeled nitrogen was immobilized.

DATA:

Primary Source.

39. CHATARPAUL, L., ROBINSON, J.B. and KAUSHIK, N.K.
1979: Role of Tubificid Worms on Nitrogen Transformations in Stream Sediment; Journal of the Fisheries Research Board of Canada, Vol. 36, No. 6, p. 673-678.

ABSTRACT:

Sediments obtained from Swifts Brook were highly organic whereas those from Canagagigue Creek were coarse-textured with relatively

little organic content. Columns of sediment were overlain with continuously aerated 10 mg/L nitrate-N solution or distilled water. When columns of Canagagigue sediment with tubificid worms (Tubifex tubifex and Limnodrilus hoffmeisteri) were incubated for 33 d they lost nitrate-N at a significantly higher rate ($P<0.01$) than did columns without worms. Following the initial period of nitrate disappearance (resulting from denitrification in the sediment) nitrate-N increased again, this increase being greatest in the presence of worms. The increasing concentration of nitrate-N probably resulted from nitrification which was masked early in the experiment by rapid denitrification. In columns with Swifts Brook sediment, added nitrate disappeared rapidly but no significant difference was observed to increase. Possibly both nitrification and denitrification are also enhanced here by the presence of tubificids but the effects are masked.

DATA:

Primary Source.

40. CHATARPAUL, L., ROBINSON, J.B. and KAUSHIK, N.K.
1980: Effects of Tubificid Worms on Denitrification and Nitrification in Stream Sediment; Canadian Journal of Fisheries and Aquatic Sciences, Vol. 37, No. 4, p. 656-663.

ABSTRACT:

Labeled nitrate-N in the form of $K^{15}NO_3$ was used to determine the effects of the tubificid oligochaetes, Tubifex tubifex and Limnodrilus hoffmeisteri, on the N transformation processes in stream sediment contained in laboratory columns. Dentrification and nitrification occurred simultaneously and were enhanced significantly in the presence of the worms. The denitrification rate over 48 d at 15°C in the sediment that contained the worms was 90mg $N/m^2.d^{-1}$; the simultaneous rate of nitrification was 69 mg $N/m^2.d^{-1}$ and 29 mg $N/m^2.d^{-1}$. The rate of $CO_2$ evolution from sediment containing worms and overlain with nitrate-N solution was about 21% greater than that of sediment with worms overlain with distilled water. It was concluded from experiments using chloride as tracer that denitrification could be enhanced by the worms at least in part as a result of accelerated movement of nitrate-N into the sediment. However, when a column of glass beads was used as a substrate for worms, and with no organic matter present, the concentration of nitrate in an overlying solution declined at an appreciable rate. This suggested that denitrification occurred in or on the worms, a possibility supported by the observation that denitrifying bacteria could be isolated from both the exterior and the gut contents of the worms.

DATA:

Primary Source.

41. CHAU, Y.K., WONG, P.T.S., BENGERT, G.A. and DUNN, J.L.
1984: Determination of Dialkyllead, Trialkyllead, Tetraalkyllead and Lead (II) Compounds in Sediment and Biological Samples; Analytical Chemistry, Vol. 56, No. 2, p.271-274.

ABSTRACT:

A tissue solubilizer is used to dissolve biological samples without altering the chemical forms of the alkyllead species. The various alkyllead species and lead(III) are isolated quantitively by chelation extraction with sodium diethyldithlocarbamate, followed by n-butylation to their corresponding tetraalkyl forms, $R_nPbBu_{(4-n)}3$ and $Bu_4Pb$, respectively (R=Me, Et), all of which can be determined by a GC/AAS method. The method determines simultaneously the following species in one sample: tetraalkyllead ($Me_4Pb$, $Me_3EtPb$, $Me_2Et_2Pb$, $MeEt_3Pb$, $Et_4Pb$); ionic alkyllead ($Me_2Pb^{2+}$, $Et_2Pb^{2+}$, $Me_3Pb^{+}$, $Et_3Pb^{+}$); $Pb^{2+}$. Analysis of sediment, fish, and aquatic weeds are given. Detection limits expressed for Pb are 7.5 ng/g and 15 ng/g, respectively, for biological and sediment samples.

DATA:

Primary Source.

42. CHAU, Y.K., WONG, P.T.S., BENGERT, G.A., DUNN, J.L. and GLEN, B.
1985: Occurrence of Alkyllead Compounds in the Detroit and St. Clair Rivers; Journal of Great Lakes Research, Vol. 11, No. 3, p. 313-319.

ABSTRACT:

Environmental occurrence of alkyllead compounds, both of molecular species, e.g., tetraalkyllead, and ionic species, e.g., dialkyllead and trialkyllead, is believed to be derived mainly from anthropogenic sources such as effluents of alkyllead production plants and from slow degradation of tetraalkyllead in the environment. The present study describes a survey for the occurrence of tetraalkyllead in the environment. The present study describes a survey for the occurrence of tetraalkyllead, trialkyllead, dialkyllead, and pb(II)(R=Me, Et) in water, surface microlayer, fish, and sediments from 29 stations in the St. Clair and Detroit rivers, including the western basin of Lake Erie. Results indicated that triethyllead and diethylead compounds have been found for the first time in fish and surface microlayer in St. Clair River near Corunna where a production plant is located. About 48% of the surface microlayer samples contained various alkyllead compounds whereas only one water sample taken from the St. Clair River was found to contain alkyllead. Alkyllead compounds were found in several species of fish caught in the St. Clair River, with northern pike containing the highest concentration of alkyllead (0.173 µg/g) followed by white

sucker, carp, and walleye. The concentrations of alkyllead in some individual fish reached the p.p.m. level which is considered highly hazardous for consumption although health criteria for alkyllead are not yet available. The ratios of alkyllead to total lead ranged from 0% for yellow perch and brown trout to 56% for carp.

DATA:

Primary Source.

43. CHOO-YING, A.V.
1982: Cookstown - Innisfil Creeks, Water Quality Survey, 1980; Report, Ontario Ministry of the Environment, Water Resources Assessment Unit, Technical Support Section, 30p.

ABSTRACT:

The water quality survey of Cookstown Creek and Innisfil Creek was carried out to provide background information in anticipation of an application for a certificate of approval for a proposed water pollution control plant for the Village of Cookstown. The data from this report would be used eventually to set preliminary effluent guidelines for this plant.

Cookstown and Innisfil Creeks support a fishery consisting mainly of bait fish. The predominant stream water use is for irrigation and there are several locations on Innisfil Creek where water is extracted for this purpose. The approved combined maximum rate of extraction could amount to the major portion of the flow in the stream during the low flow period. Although not observed, there is cattle watering from the streams.

The water quality for both streams met the Provincial Water Quality Objectives or Guidelines for some parameters and violated others. Total phosphorous concentrations were particularly high, and the geometric mean bacteria densities exceeded the objectives for body contact recreational uses. The waters were alkaline and combined with high temperatures, an ammonia rich effluent input could cause exceedence of the objective for un-ionized ammonia.

Cookstown Creek is not a suitable receiver for the treated effluent from the proposed water pollution control plant because of the lack of stream flow. During dry periods, zero flows do occur, e.g., on July 15, 1980 at Station 2 (02ED110). Innisfil Creek is a more suitable receiver because of greater flows. The minimum average day flow for 1980 was 124 litres per second at Station 6 (02ED109); but since the 1980 summer-fall flows were higher than normal, based on the flow records for Station 02ED003 on the Nottawasaga River at Baxter (1948-1980), during years drier than 1980, lower flows could be expected. Then again, the major portion of the flow could be utilized for irrigation.

The effluent from the proposed plant would require a high degree of treatment to maintain a water quality in the receiving stream consistent with the Provincial Water Quality Objectives. Of the effluent quality parameters, ammonia is of prime concern because of its toxicity to fish. Similarly, chlorine is of concern if it will be used as the disinfecting agent.

DATA:

Primary Source.

44. CHRISTIE, A.E.
1973: Seston Carbon, Nitrogen, Phosphorus and Phytoplankton from Eight Southern Ontario Lakes; Research Report No. W46, Ontario Ministry of the Environment, 17p.

ABSTRACT:

Seston samples from eight lakes lying within the Trent River Drainage Basin, located in central Ontario, were characterized with respect to three nitrogen fraction, three phosphorus fractions, organic carbon, phytoplankton content and chlorophyll a.

Significant direct positive relationships were found to exist between each of the nutrient parameters and the algal biomass. Nonlabile nitrogen or phosphorus to biomass ratios - mg.$N_3$:$cm^3$ algae - 7.3:1; mg $P_3$:$cm^3$ algae - 0.6:1; mg.$N_3$: mg chlorophyll a - 6.7:1; mg $P_3$: mg chlorophyll a - 0.6:1 - showed close agreement with similar ratios obtained with samples from a previous study in the Bay of Quinte.

DATA:

Primary Source.

45. CHURCH, M.
1978: Sediment and nutrient loadings to Lake Ontario; methodological arguments: discussion; Canadian Journal of Earth Sciences, volume 15, no. 4, p.668-669.

ABSTRACT:

This is a discussion pertaining to the paper presented by E.D. Ongley, J.G. Ralston and R.L. Thomas.

DATA:

Secondary Source; refer to Ongley et al. (1977).

46. CLARK, D.J.
1981: An Expression for Determining Sediment Delivery Ratios; Unpublished M.Sc. Thesis, Department of Civil Engineering, University of Guelph, 106p.

ABSTRACT:

Increasing concern regarding the sediment loadings of lakes, and rivers has reinforced the need for a methodology for determining the spatial distribution of areas contributing extensively to these loads (ie: critical sediment source areas).

An expression for determining spatially distributed sediment delivery ratios has been developed. This expression is spatially and temporally compatible with existing methodologies for determining potential in-situ gross erosion. The expression makes use of easily quantifiable physical and hydrological characteristics of the watershed and can be applied at a watershed discretization level of field size or smaller.

The expression has been calibrated on the Canagagigue West Watershed in Ontario. Sensitivity analyses of related parametric values to a characteristic range of variable values have been carried out together with the sensitivity of actual delivery ratios to changes in related variable values.

The expression is practical for application in watershed studies, can be used to delineate critical sediment source areas within a watershed, and has the potential to predict the affects of proposed remedial measure strategies on delivery ratios.

DATA:

Secondary Source; refer to Water Survey of Canada data.

47. COKER, W.B.
1974: Lake Sediment Geochemistry in the Superior Province of the Canadian Shield; Unpublished Ph. D. Thesis, Department of Geological Sciences, Queen's University, Kingston, 297 p.

ABSTRACT:

Conventional geochemical exploration techniques involving the sampling and analyses of stream sediments, soils and bedrock have found limited application in the areas of glacial overburden with indefinite and disorganized drainage systems as exist in large regions of the Canadian Shield. In such areas lake sediment composition could be an indicator of mineralization if either the host rock or the mineralization itself has some diagnostic geochemical characteristic which is transmitted to lake sediments. If these conditions are fulfilled, lake sediment sampling would offer a convenient procedure for reconnaissance

scale exploration in Shield areas. The usefulness of the procedure has been previously demonstrated in permafrost areas of Canada. In the southern Shield, where organic production is much greater, trace element dispersion in lake sediments is controlled by a number of factors contributing to the existence of a complex relationship between lake sediment geochemistry and mineralization.

Orientation surveys were carried out over four greenstone belts within the Superior Province to investigate the nature and factors affecting trace element accumulation in lake sediments. This was done to evaluate the feasibility of utilizing lake sediments as a sample medium in reconnaissance surveys. These investigations indicated that the most representative and homogeneous sample of a single lake basin occurs in the central regions of a lake. It was difficult, if not impossible, to distinguish a lake adjacent to mineralization from one in barren terrain on the basis of the single element compositions of the organic rich material from the lake centres. This is due to the existence of various dispersion processes, related to coprecipitation and varying pH, that affect the distribution of trace elements in lake sediments. Trace element dispersion in lake sediments related to massive sulphide mineralization as opposed to other causes can be identified by screening the Zn content of the sediments on the basis of Zn/Mn ratios.

A reconnaissance survey based on the collection and analyses of organic rich lake sediments from lake centres showed that the distribution of Ni and Zn when screened by ratioing Ni/Mn and Zn/Mn respectively, can be used to identify lakes adjacent to the Ni-Cu and massive sulphide mineralization respectively. The Shebandowan Ni-Cu deposit is clearly indicated by a group of lake sediment samples with anomalous Ni/Mn values extending southwest and down ice from the deposit. The distribution of Ni in the Shebandowan Lake area corresponds markedly to that of Cr indicative of a common source, in this case basic and ultrabasic strata. Lake sediment samples with anomalous Ni/Mn values, however, appear to have an additional component of Ni which is not related to coprecipitation (Mn) or bedrock (Cr) and which is believed to be a reflection of Ni-Cu mineralization. In the Sturgeon Lake area a group of samples with anomalous Zn/Mn values encompasses the Mattabi and Lyon Lake massive sulphide mineralization. There is also a group os anomalous samples, confirmed by follow-up work, to the east of the Mattabi and Lyon Lake deposits. This anomaly occurs in a favourable geological environment and is associated with geophysical conditions indicative of possible mineralization. Currently this area is under further geological geophysical investigation.

Final assessment of the technique must await the results of the current programme to evaluate the significance of the anomalies revealed by the reconnaissance. Provisionally however it is concluded that sampling and analyses of organic rich lake sediments followed by screening of the data may be a viable exploration procedure in the search for Ni-Cu and base metal

massive sulphide deposits in the southern areas of the Canadian Shield.

DATA:

Primary Source.

48. COKER, W.B. and NICHOL, I.
1975: The Relation of Lake Sediment Geochemistry to Mineralization in the Northwest Ontario Region of the Canadian Shield; Economic Geology, Vol. 70 No. 1, p.202-213.

ABSTRACT:

Conventional geochemical exploration techniques involving the sampling and analyses of stream sediments, soil, and bedrock have found limited application in the areas of glacial overburden with indefinite and disorganized drainage systems such as exist in large regions of the Canadian Shield. In such areas lake sediment composition could be an indicator of mineralization if either the host rock or the mineralization itself has some diagnostic geochemical characteristic which is transmitted to lake sediments. If these conditions are fulfilled, lake sediment sampling would offer a convenient procedure for reconnaissance-scale exploration in Shield areas. The usefulness of the procedure has been previously demonstrated in permafrost areas of Canada. In the southern Shield, where organic production is much greater, trace element dispersion in lake sediments is controlled by a number of factors contributing to the existence of a complex relationship between lake sediment geochemistry and mineralization. Orientation surveys were carried out over four greenstone belts within the Superior Province to investigate the nature and factors affecting trace element accumulation in lake sediments in order to evaluate the feasibility of utilizing lake sediments in reconnaissance exploration. These investigations indicated that the most representative and homogeneous sample of a single lake basin occurs in the central regions of a lake. It was difficult, if not impossible, to distinguish a lake adjacent to mineralization from one in barren terrain on the basis of the single element compositions of the organic-rich material from the lake centers. This is due to the existence of various dispersion processes, related to coprecipitation and varying pH, that affect the distribution of trace elements in lake sediments. Trace element dispersion in lake sediments related to massive sulfide mineralization as opposed to other causes can be identified by screening the Zn content of the sediments on the basis of Zn/Mn ratios. A reconnaissance survey based on the collection and analysis of organic-rich lake sediments from lake centers showed that the distribution of Ni and Zn when screened by ratioing Ni/Mn and Zn/Mn, respectively, can be used to identify lakes adjacent to the Ni-Cu and massive sulfide mineralization, respectively. The Shebandowan Ni-Cu deposit is clearly indicated by a group of lake

sediment samples with anomalous Ni/Mn values extending southwest and down ice from the deposit. The distribution of Ni in the Shebandowan Lake area corresponds markedly to that of the Cr indicative of a common source, in this case basic and ultrabasic strata. Lake sediment samples with anomalous Ni/Mn values, however, appear to have an additional component of Ni which is not related to coprecipitation (Mn) or bedrock (Cr) and which is believed to be a reflection of Ni-Cu mineralization. In the Sturgeon Lake area a group of samples with anomalous Zn/Mn values encompasses the Mattabi and Lyon Lake massive sulfide mineralization. There is also a group of anomalous samples, confirmed by followup work, to the east of the Mattabi and Lyon Lake deposits. This anomaly occurs in a favorable geological environment and is associated with geophysical conditions indicative of possible mineralization. Final assessment of the technique must await the results of the current program to evaluate the significance of the anomalies revealed by the reconnaissance. Provisionally, however, it is concluded that sampling and analysis of organic-rich lake sediments followed by screening of the data may be a viable exploration procedure in the search for Ni-Cu and base metal massive sulfide deposits in the southern areas of the Canadian Shield.

DATA:

Secondary Source; refer to Coker (1974).

49. CONSERVATION MANAGEMENT SYSTEMS

1986: Sediment Issues and Data Needs in Ontario; Final Report Submitted to Environment Canada, Water Resources Branch, Sediment Survey Section, 81 p.

ABSTRACT:

This report presents results obtained from a study of sediment issues and programs in Ontario and is one of several reviews across Canada to establish a national perspective on sediment issues and related program needs for Environment Canada. The Ontario study involved the use of a questionnaire and interviews with a cross section of sediment data users and collectors in the province, a one-day workshop of data users, and an extensive literature review. Results are combined, organized and discussed under the heading of sediment issues, knowledge, data and information systems. The report identifies needs and makes recommendations regarding the data base, sampling strategies and methods, and the sediment information system.

DATA:

Secondary Source; refer to Water Survey of Canada and Ontario Ministry of the Environment data.

50. COOTE, D.R. and DEHAAN, R.
1978: Agricultural Watersheds Overview Data Analysis and Extrapolation; Report, Task Group C (Canadian Section) Activity 1, Project 1B, PLUARG, International Joint Commission, Windsor, 79p.

ABSTRACT:

There has been a persistent gap between the two most generally available forms of information on the effects of agriculture on water quality. These two forms of information are the results of small scale "pilot" studies and large scale river basin or lake loading analyses. The former are usually limited in terms of variability of soil, management and climatic conditions; the latter generally fail to distinguish between even distinctly different types of agricultural environments. The results of this study help to bridge the gap between these different approaches.

The role of soil particle size as a major influence on total phosphorus, organic nitrogen, zinc and atrazine loadings from agricultural land has been clearly indicated.

The influence of source material availability on stream loadings of the more water soluble contaminants in streams is evidenced by the loadings of soluble ortho-phosphorus and nitrate nitrogen which can be accounted for to a considerable degree by the inputs (fertilizer and manure) of phosphorus and nitrogen, respectively.

The results indicate that some materials, such as PCB and copper, are essentially unrelated to any aspect of agriculture. Control or reductions should not be expected through any remedial programs applied to agricultural activities.

Prediction equations based on statistical regressions of stream loadings on physical and management characteristics of the watersheds appear to be feasible for some water quality parameters such as total and soluble ortho-phosphorus, total nitrogen and nitrate (plus nitrite) nitrogen. Attempts to extrapolate regression equations for sediment (suspended solids) appear less satisfactory. For most other parameters, the extrapolation of regression equations would appear unreliable, though the occurrence of pesticides which are fairly specific to certain crops may be extrapolated by considering the distribution of the appropriate crops.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

51. COOTE, D.R., MacDONALD, E.M. and DICKINSON, W.T.
1978: Agricultural Watershed Studies, Great Lakes Drainage Basin; Final Summary Report, Task Group C (Canadian Section), PLUARG, International Joint Commission, Windsor, 78 p.

ABSTRACT:

This summary report contains information prepared by scientists who have interpreted the results obtained by all of the projects conducted within the Canadian PLUARG (Pollution from Land Use Activities Reference Group) Task C Agricultural Watershed Study. These studies consisted of a variety of investigations into the relationships between agricultural land and water quality in the Great Lakes basin. Monitoring of water quality and quantity at 11 small (19-73 sq km) watersheds, selected to be representative of major agricultural regions in the Canadian Great Lakes Basin, was carried out for two years. Detailed studies on sediment, nutrients, and heavy metals were carried out in some of the watersheds. The study approach is presented, along with summaries and discussion of data, and possible remedial measures for all of the major water quality parameters investigated of which total phosphorus and sediment were of the greatest concern to PLUARG. Extrapolation to unmonitored areas and remedial measures alternatives are discussed for total phosphorus and sediment. Consideration was given to remedial programs to reduce the contributions of pollutants from agricultural activities. To illustrate the site-specific nature of, and demonstrate an approach to, remedial measures, programs were developed for four watersheds and phosphorus and sediment loading reductions and costs were estimated. Three examples are presented in this report. Monitoring and detailed studies were also carried out to determine the role of agricultural land as a source of other water quality parameters.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

52. COOTE, D.R., MACDONALD, E.M., DICKINSON, W.T., OSTRY, R.C. and FRANK, R.
1982: Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds; Journal of Environmental Quality, Vol. II, No. 3, p.473-481.

ABSTRACT:

The 1972 U.S.-Canada Great Lakes Water Quality Agreement established the Pollution from Land Use Activities Reference Group (PLUARG). To meet the objectives of the Pilot Watershed Studies of PLUARG, an approach was developed that would allow the quantification of the agricultural component of Great Lakes drainage basin pollution loads. A primary separation of

agricultural regions was based on an index of the soil's potential to transfer pollutants to surface and ground water. Agricultural watersheds representative of major soils-crops-livestock combinations were monitored and studied. Selection and preliminary monitoring processes led to 11 sites being monitored for 2 years.

The areas of the 11 study watersheds ranged from 20 to 79 $km^2$, of which 22-89% was cultivated, and 0-99% tile-drained. Row-cropped land, which occupied 10-66% of the watershed areas, was strongly correlated with tile-drained area and fertilizer use. Mean surface-soil clay contents ranged from 7 to 36%. Livestock densities were negligible in some watersheds, but were up to 0.77 animal units $ha^{-1}$ in others. Mean precipitation and stream discharge during the study period were approximately 9 and 26% higher, respectively, than expected from long-term means. The proportion of annual precipitation occurring in the January-April period averaged 32%, while approximately 65% of the stream discharge was measured during these 4 months.

Intensive flow-related stream sampling and chemical analyses, revealed that the watersheds yeilded a wide range of nutrient, sediment, and pesticide loadings to Great Lakes tributaries. The subsequent papers in this series discuss the results and their significance to water quality in the Great Lakes Basin.

DATA:

Secondary Source; refer to Water Survey of Canada data.

53. CROCKET, J.H. and KABIR, A.
1981: Geochemical Pathway Studies of Heavy Metals in Lake Sediments from the Sudbury-Temagami Area, Ontario; Journal of Great Lakes Research, Vol. 7, No. 4, p.455-466.

ABSTRACT:

The concentrations of some heavy metals in lake sediments from the Sudbury-Temagami area were determined by radiochemical neutron activation, atomic absorption, and x-ray fluorescence. Data for dredge samples from 23 lakes indicate that concentration gradients for Pd, As, and Se tend to center about the Sudbury industrial complex and increase toward it. Metal concentration profiles over the top 20 cm of sediment cores from five lakes show pronounced increases in Pd, Ir, Au, As, Se, Cu, Ni, and Pb in the top 5 cm. These data suggest that one of the principal pathways for heavy metal loading of lake sediment in the area is atmospheric fallout of particulate material.

DATA:

Primary Source.

54. CROCKET, J.H. and TERUTA, Y.
1976: Pt, Pd, Au and Ir Content of Kelley Lake Bottom Sediments; Canadian Mineralogist, Vol. 14, No. 1, p.58-61.

Three samples of Kelley Lake (Sudbury district, Ontario) bottom sediment average (in ppm) 1.8 Pt, 0.2 Pd, 0.3 Au, and 0.03 Ir. These concentrations are in excess of the noble-metal concentrations of common rocks by factors of 100 to 1000. It is unlikely that rock weathering in the drainage basin or input of glacial sediment is a significant contributor of noble metals at these levels. Comparison of the average noble-metal content of Sudbury Irruptive sulfide ores with Kelley Lake sediment does not support normal weathering of the ore deposits as a major source of noble metals. Evidence from nickel content versus lake sediment core depth indicates that the Ni levels in Kelley Lake bottom sediment reflect human activity. Such is also probably the most reasonable explanation for the high noble-metal levels. An analysis of a stack particulate sample showed significantly higher noble-metal content for all four metals than Kelley Lake sediment. The possible significance of atmospheric loading as a contributor of noble metals to Kelley Lake bottom sediment is briefly considered.

DATA:

Primary Source.

55. CROSS, P.M.
1977: An Attempt to Estimate Phosphorus Retention in Bob Lake from Iron Retention and the Iron: Phosphorus Ratio in the Sediments; Unpublished M. Sc. Thesis, University of Toronto, Toronto, 121 p.

ABSTRACT:

Iron and phosphorus budgets of an oligotrophic lake on the Canadian Shield are calculated from measurements of input from terrestrial and aeolian sources and outputs from the lake. The iron to phosphorus ratio was measured in the sediments and used to calculate the quantity of phosphorus retained by the lake from the measured quantity of iron retained. Results show that the lake retained 76.6% of the iron input and 73.6% of the phosphorus retained by the lake is 321 kg calculated from the phosphorus budget and 385 kg calculated from the iron budget and iron to phosphorus ratio in the sediments.

DATA:

Primary Source.

56. CROSS, P.M. and RIGLER, F.H.
1983: Phosphorus and Iron Retention in Sediments Measured by Mass Budget Calculations and Directly; Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 10, p.1589-1597.

ABSTRACT:

Retention of phosphorus (P) and iron (Fe) was estimated from mass budget calculations of Bob Lake, Ontario. Ratios of Fe to P in sediment cores were used to test the reliability of the concurrent retention estimated. However, a 300% range in Fe to P ratios measured in vertical profiles in sediments was many times larger than the uncertainty associated with mass budget measurements. Sediment cores showed a near-surface maximum of iron but not phosphorus. There was reasonably good agreement between P retention as computed by mass budget and by sediment accumulation methods, though the latter were slightly higher.

DATA:

Primary Source.

57. CULLEY, J.L.B. and BOLTON, E.F.
1983: Suspended Solids and Phosphorus Loads from a Clay Soil: II. Watershed Study; Journal of Environmental Quality, Vol. 12, No. 4, p. 498-503.

ABSTRACT:

Clay soils are very important agriculturally in southwestern Ontario, and they constitute a large proportion of the Canadian Lake Erie drainage basin. Analysis of water quality and quality from a typical clay watershed indicated that estimates of suspended solids load varied substantially, depending on the calculation method; this was not the case for P. Effluent from subsurface drains was estimated to constitute about 60% of annual runoff from the watershed. About 32 and 18% of the suspended solids load was probably derived from bank erosion and subsurface drainage, respectively. Contribution of P from these sources was also substantial. Sediment delivery of eroded soil from cropland was estimated to be about 7% of the sheet and rill erosion rate.

DATA:

Primary Source.

58. CULLEY, J.L.B., BOLTON, E.F. and BERNYK, V.
1983: Suspended Solids and Phosphorus Loads from a Clay Soil: I. Plot Studies; Journal of Environmental Quality, Vol, 12, No. 4, p. 493-498.

ABSTRACT:

Phosphorus and suspended solids (SS) contents in tile discharge from two southwestern Ontario clay soil drainage experiments were measured over a 2 y period. For continuous corn (Zea Mays L.) plots, loads of SS and total P were 407 and 0.88 kg $ha^{-1}y^{-1}$, respectively. Suspended solids and total P loads from drains beneath permanent sod were 97 and 1.85 kg $ha^{-1}y^{-1}$, respectively. Comparison of these results with limited data on P and SS loads in surface runoff indicated that >50% of the total P load from these nearly level plots may be lost via subsurface tile flow. Overall, 34% of the total P load from subsurface drains was sediment-associated. Furthermore, crop cover, P fertilization rate, and tile drain depth were found to significantly affect dissolved P export. Dissolved P concentrations in effluent from permanent bluegrass sod exceeded those from continuous corn and rotational plots. Subsurface sediment and sediment-associated P loads were highest from continuous corn. Greater soil cover over the tile line decreased both sediment and P concentrations. Sediment-associated P concentrations increased with P fertilization rate at one of the experimental locations.

DATA:

Primary Source.

59. CWYNAR, L.C.
1978: Recent History of Fire and Vegetation from Laminated Sediment of Greenleaf Lake, Algonquin Park, Ontario; Canadian Journal of Botany, Vo. 56, No. 1, p. 10-21.

ABSTRACT:

Laminated sediment (presumed varved) from Greenleaf Lake was examined for evidence of forest fires. A 500-year section dating approximately 770-1270 A.D. was analysed for influx of pollen, charcoal, aluminum, and vanadium using decadal samples. Intervals showing concurrent peaks in charcoal, aluminum, and vanadium influx, varve thickness, and charcoal:pollen ratio were interpreted as representing major fires within the drainage basin of Greenleaf Lake. By these criteria, six fires occurred within 500 years, or one fire approximately every 80 years. The pollen diagram indicates a stable forest composition for the past 1200 years. This, coupled with abundant charcoal fragments in all sediment samples, suggests that fire has been a frequent, natural phenomenon affecting the landscape during this period. There is a significant positive correspondence between peak charcoal influxes and peak influxes of aluminum and vanadium, indicating that increased soil erosion is responsible for their deposition.

DATA:

Primary Source.

60. DICKINSON, W.T.
1981: Accuracy and Precision of Suspended Sediment Loads; Proceedings of the Florence Symposium on Erosion and Sediment Transport Measurement. International Association of Hydrological Sciences, IASH Publication No. 133, p.195-202.

ABSTRACT:

The effects of five computational methodologies and four sampling frequencies on the accuracy and precision of annual suspended sediment load estimates have been explored. The mean ratio of the estimated annual suspended load to the population suspended sediment load has been determined for each method and frequency as an index of accuracy. The standard deviation of the ratio has been determined as an index of precision. Some computational methods have been found to be both precise and accurate over a range of sampling frequencies. One method appears to be reasonably precise but very inaccurate; another reasonably accurate but not precise. The results are seen to be extremely important for the selection of both sampling schemes and computational techniques for suspended sediment studies, and for the evaluation of existing data sets.

DATA:

Secondary Source; refer to Water Survey of Canada data.

61. DICKINSON, W.T.
1982: Occurence and Control of Soil Erosion and Fluvial Sedimentation in Selected Basins of the Thames River Watershed; Technical Report No. R-5, Stratford-Avon Environmental Management Project, 33p.

ABSTRACT:

This report summarizes results from the application of the soil-loss/sediment-delivery model GAMES to selected small watersheds in the Avon River and lower Thames River basins. GAMES was developed to describe and predict soil loss by water erosion and the subsequent delivery of suspended solids from field to stream and downstream in agricultural areas.

The modelling analysis indicates that it is well to consider the rolling upland watersheds such as the Avon basin somewhat differently than the level watersheds of the lower Thames basin when assessing soil erosion and stream sediment problems. In the upland watersheds, average soil loss rates may not be considered excessive though there is evidence of localized erosion problems. Sediment sources are even more localized than the erosion-prone sites. Erosion and sediment delivery can therefore be effectively achieved by the application of remedial measures to site-specific problem areas.

The level lowland watersheds, on the other hand, present neither general nor local soil erosion problems, the estimated soil-loss rates being relatively low. If either the low erosion rates or the sediment delivery rates are to be controlled for reasons of agricultural productivity or water quality, then widespread control measures would be required. These would involve extensive changes in soil and crop management systems.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data and Wall et al. (1978).

62. DICKINSON, W.T., PALL, R. and WALL, G.J.
1984: GAMES - A Method for Identifying Sources and Amounts of Soil Erosion and Fluvial Sediments; Proceedings of the Fifteenth Canadian Hydrology Symposium on the Water Quality Evolution Within the Hydrological Cycle of Watersheds, University of Laval, Quebec, June 10-12, 1984, p.805-825.

ABSTRACT:

GAMES, the Guelph model for evaluating the effects of Agricultural Management systems on Erosion and Sedimentation, predicts soil loss by water erosion and subsequent delivery of suspended solids to streams. It accommodates spatial units of any size and shape, the time frame separates seasonal changes in soil erodibility, in cropping, and in rainfall characteristics, and the model accommodates changes in soil and crop management conditions. The soil loss component of GAMES is based on the Universal Soil Loss Equation. The percent field soil loss delivered to the main stream channel is determined from a delivery ratio function which incorporates surface roughness, land slope, hydrologic condition, and length of overland flow path. The output generated for spring and for summer conditions includes: potential soil erosion, soil erosion/ha, cell delivery ratio to the adjacent cell, cell delivery ratio to the stream, sediment delivered to the stream and sediment yield/ha.

GAMES has been applied to small watersheds selected from across southern Ontario. The results indicate: (i) The average gross erosion per hectare is variable across the landscape but is not large. (ii) The average sediment yield per hectare is also variable and not large. (iii) A major portion of the eroded solid in upland watersheds moves within a small percentage of the watershed areas. One example shows 64 percent of potential soil erosion in the spring in 25 percent of the watershed. On the other hand, erosion in the lowland study areas is much more uniform across the watersheds. (iv) Nearly all the suspended sediment leaving the upland watersheds emanates from a very small percentage of the watershed areas. For example, 62 percent of the spring sediment load in the upland basin noted above in generated

in 15 percent of the watershed (14 percent in generated in 1 percent of the area). Sediment yield in the lowland-study areas is much more uniform. (v). Steeply-sloped, fallow fields near main stream channels exhibit high erosion rates nd high sediment yields. Level fields located near the stream with poor or imperfect internal damage have high delivery ratios and tend to yield moderate to high sediment loads. Steeply-sloped, row-cropped fields remote from drainage channels contribute little or no sediment to the stream.

DATA:

Secondary Source; refer to Wall et al. (1978).

63. DICKINSON, W.T., RUDRA, R.P. and CLARK, D.J.
1986: A Delivery Ratio Approach for Seasonal Transport of Sediment; Proceedings of the Symposium on Drainage Basin Sediment Delivery, August 4-8, 1986, Albuquerque, New Mexico, International Association of Hydrological Sciences, IASH-AISH Publication No. 159, p.237-252.

ABSTRACT:

An expression for determining spatially distributed sediment delivery ratios has been developed. This expression is spatially and temporally compatible with existing methodologies for determining potential in-situ gross erosion. The expression makes use of easily quantifiable physical and hydrological characteristics of the waterhsed and can be applied at a watershed discretization level of field size or smaller. The expression has been calibrated on the Canagagigue West Watershed in Ontario. Sensitivity analyses of related parametric values to a characteristic range of variable values have been carried out together with the sensitivity of actual delivery ratios to changes in related variable values. The expression is practical for application in watershed studies, can be used to delineate critical sediment source areas within a watershed, and has the potential to predict the effect of proposed remedial measure strategies on delivery ratios.

DATA:

Secondary Source; refer to Water Survey of Canada data.

64. DICKINSON, W.T., RUDRA, R.P. and WALL, G.J.
1985: Discrimination of Soil Erosion and Fluvial Sediment Areas; Canadian Journal of Earth Sciences, Vol. 28, No. 8, P. 1112-1117.

ABSTRACT:

A computer model has been used to estimate potential sheet and rill erosion and delivered sediment from field-sized areas of five selected agricultural watersheds. Consideration of these

estimates in relation to defined tolerance levels of soil erosion and sediment yield has resulted in the mapping of (1) areas that exhibit erosion problems and serve as sediment sources; (2) areas that exhibit only erosion problems (but do not act as sediment sources); (3) areas that serve only as sediment sources (but do not act as sediment sources); (3) areas that serve only as sediment sources (but do not exhibit erosion problems); and (4) areas that have no significant erosion problems or sediment sources. A simple approach has been developed for the preparation of such maps on the basis of a limited data base involving factors affecting erosion and fluvial sedimentation. This relatively simple yet accurate technique offers agricultural and conservation extension personnel a method for the identification of soil erosion problem areas and (or) sediment sources.

DATA:

Secondary Source; refer to Water Survey of Canada data.

65. DICKINSON, W.T. and SCOTT, A.M.
1979: Analysis of Streambank Erosion Variables; Canadian Agricultural Engineering, Vol. 21, No. 1, p. 19-25.

ABSTRACT:

A data base consisting of streambank erosion rates and associated physical, chemical, hydraulic, and land management conditions has been assembled for bank erosion sites in agricultural areas in Southern Ontario. The existence and nature of interrelationships among the data sets have been studied by means of various correlation and regression models. A newly defined variable, the hydraulic stability index, has been found to be functionally related to soil erodibility, agricultural activity adjacent to the bank, and the hydraulic stability index associated with the erosion site. Implications of this relationship are seen to be important not only to further studies of streambank erosion processes but also to the development of strategies for remedial measures.

DATA:

Secondary Source; refer to Knap and Mildner (1978).

66. DICKINSON, W.T., SCOTT, A. and WALL, G.
1975: Fluvial Sedimentation in Southern Ontario. Canadian Journal of Earth Sciences, Vol. 12, No. 11, p. 1813-1819.

ABSTRACT:

Suspended sediment data for Southern Ontario stream have been analyzed with regard to areal and temporal patterns, characteristics of sediment concentrations, and relationships

between sediment loads and watershed parameters. The range of annual suspended sediment yields for seven river basins is determined as 5250 to 175 000 kg/year/km$^2$. The daily suspended loads exhibit highly skewed frequency distributions, with mean loads being equalled or exceeded less than 20% of the time and 50% of the annual load occurring during the months of March and April. It is demonstrated that sample rankings determined from low flow data, are not indicative of the annual suspended sediment load picture. No simple model between suspended loads and such basin indices as relief ratio and drainage density is found to be satisfactory for prediction purposes.

DATA:

Secondary Source; refer to Water Survey of Canada data.

67. DICKINSON, W.T. and WALL, G.J.
1976: Temporal Pattern of Erosion and Fluvial Sedimentation in the Great Lakes Basin; Geoscience Canada, Vol. 3, No. 3, p. 158-163.

ABSTRACT:

The flow system of the Great Lakes Basin is considered to be composed of a land basin and a lake basin. Land runoff contributes significantly to the total water budget of the Great Lakes. The per cent of total lake outflow resulting from land runoff ranges from >50 per cent in the upper Great Lakes to <15 per cent in the lower lakes of Ontario and Erie. Fluvial sediment inputs to the Great Lakes are the resultant of complex upland erosion and sedimentation processes. These processes are not synonomous, as the magnitude and temporal distribution of field erosion losses are significantly different from fluvial sediment yields and their temporal patterns. Fluvial sediment inputs to the Great Lakes have been reported to range from 5250 to 175 000 kg/year/km$^2$ for the different climatic, physiographic and land use regions. While these values express average annual loading rates, the role of single low probability floods (e.g. 100yr storm) is important in an assessment of the magnitude of erosional losses and fluvial sediment inputs to the Great Lakes. Current knowledge of the processes, magnitudes, and sources of terrestrial erosion and fluvial sediment loading rates in the Great Lakes Basin is limited. The dynamic contributing area approach is presented as a watershed response concept which shows considerable promise for the description of upland erosion processes.

DATA:

Secondary Source; refer to Water Survey of Canada data.

68. DICKINSON, W.T. and WALL, G.J.
1977: Influence of Land Use on Erosion and Transfer Process of Sediment; Proceedings of the Workshop on the Fluvial Transport of Sediment-Associated Nutrients and Contaminants, Kitchener, October 20-22, 1976, International Joint commission, p. 37-64.

ABSTRACT:

The influence of land use on erosion and transport processes are investigated. The effects of land use sequence on relative sediment yield and channel stability are described. Plot equipment, design and size are discussed in relation to the use of plot studies to isolate factors which influence soil loss and runoff. The findings from small plot studies have shown that many variables affect erosion, but the extrapolation of plot data beyond the plot remains a problem. the usefulness of the universal soil loss equation for the prediction of watershed sediment yields and gross erosion levels is discussed and the two approaches used in studies of erosion and transport on watersheds are considered. They are sediment load monitoring and watershed models. An extensive bibliography is included.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

69. DICKMAN, M.D.
1979: A Possible Varving Mechanism for Meromictic Lakes; Quaternary Research, Vol. II, No. 1, p.113-124.

ABSTRACT:

A variety of mechanisms have been proposed to explain how light and dark couplets are formed in the profundal sediments of meromictic lakes but none of these explanations acknowledges the significance of the sudden and massive mortality of mixolimnetic anaerobic bacteria. Data collected from sedimentation chambers suspended below the chemocline in a small meromitic lake indicate that a massive mortality of photosynthetic bacteria was induced by a sudden intrusion of partially oxygenated water into the anaerobic lower mixolimnion. The resulting deposition of anaerobic bacteria (0.45 mg dry wt $cm^{-2}day^{-1}$) contributed 60% of the annual sediment influx during a 14-day period. It is postulated that the sudden sedimentation of the anaerobic bacteria inhabiting the lower mixolimnion of some meromictic lakes contributed to the formation of the dark-colored laminae in the sediments of these lakes.

DATA:

Primary Source.

70. DILLON, P.J. and EVANS, R.D.
1982: Whole-Lake Lead Burdens in Sediments of Lakes in Southern Ontario, Canada; Hydrobiologia, Vol. 91, p. 121-130.

ABSTRACT:

The anthropogenic stable lead content of the sediments of eight softwater Precambrian lakes in southern Ontario was measured at 34-92 sites per lake. Whole-lake anthropogenic lead burdens varied between only 610 and 770 mg $m^{-2}$. There was no relationship between lead burden and either water replenishment time of the lake ($T_W$) or the ratio of watershed area to lake area ($A_d/A_0$), which varied by factors of 4 and 12 respectively. These results can be explained if a) the lead deposition in this region is uniform, and b) the only significant input of lead to the lakes is via deposition from the atmosphere directly on the lakes' surfaces. Therefore spatial differences in anthropogenic lead within a lake represent the redistribution or focusing pattern of the sediments.

DATA:

Primary Source.

71. DILLON, P.J. and SMITH, P.J.
1984: Trace Metal and Nutrient Accumulation in the Sediments of Lakes Near Sudbury, Ontario; In: Environmental Impacts of Smelters, J.O. Nriagu, Editor, Advances in Environmental Science and Technology, Wiley, Vol. 15, p. 375-416.

ABSTRACT:

The authors have investigated the trace metal (Cu, Ni, Zn, Pb, Cd), Al, Fe and nutrient (TP, TN) content of the sediments of four lakes in the Sudbury area - Clearwater, Lohi, Middle, and Hannah lakes. The purposes of the studies were to establish the effects of acidification of the lakes on their sediment chemistry, to determine if the neutralization and fertilization experiments carried out on these lakes resulted in measurable changes in their sediment chemistry, and to test the hypothesis that the increase in trace metal content in the sediments of lakes in this area is a result of mining and smelting activities.

DATA:

Primary Source.

72. DUANE, D.B.
1967: Characteristics of the Sediment Load in the St. Clair River; Proceedings of the Tenth Conference on Great Lakes Research, University of Toronto, Toronto, April 10-12, 1967, p. 115-132.

ABSTRACT:

Data pertaining to the characteristics of the sediment load in the St. Clair River were collected in the spring and fall of 1965 at a section downstream from the Blue Water Bridge. Analysis of the data indicates that both suspended load and bedload vary with time and location in the river cross section. In general the sediment load is directly related to waves impinging upon lower Lake Huron beaches, i.e., waxing and waning in phase with the rise and fall of energy expeded on the beach and nearshore bottom. Data indicate also that the distribution of the load is not symmetrical.

Material comprising the suspended load is a combination of particulate terrigenous matter and an organic material similar to filamentous fibrous alga. Terrigenous material in suspension has a grain size rangeing from -1.40 phi (2,640 microns) to 1.98 phi (253 microns). In overall aspect the sand grains comprising sediment load in the St. Clair River are identical to the sand comprising the beaches and nearshore bottom of lower Lake Huron.

The river profile at the metered section shows remarkable uniformity as depicted by soundings made in 1959, 1960, 1962 and 1965. This aspect of the channel, reinforced by characteristics of the sediment load in in situ observations of portions of the river bottom, indicate that the St. Clair River, in the upper reaches, has a stable channel.

DATA:

Primary Source.

73. DUBE, D. et al.
1978: Data Quality Assurance for Watershed and Land Use Studies; Report, Task Group C, PLUARG, International Joint Commission, Windsor, 33p.

ABSTRACT:

To ensure adequate quality control within its studies, PLUARG investigators took a number of actions. They developed a quality control handbook that described the necessary protocol to determine if sampling, sample handing, and sample analyses produced data of the necessary integrity to support specific study conclusions. In addition, they called for remedial actions when a laboratory was found to perform inadequately.

Subsequently, to meet the sample quality control requirement a quality assurance program was instituted. It was comprised of interlaboratory analytical performance tests, blind replicate precision tests and the documentation of analytical methods and intralaboratory quality control procedures.

Fifteen interlaboratory analytical performance studies were conducted for nutrients, demand, minerals, metals and pesticides in water and for metals, nutrients and pesticides in sediments. In addition, similar ancillary studies were carried out by several Canadian laboratories. Several hundred blind field replicate samples were taken and analyzed. Data from these replicates were reviewed by principal investigators and staff of the IJC Great Lakes Regional Office. Each participating laboratory produced descriptions of its analytical methods and "in-house" quality control procedures. All data and documentation derived from the program were assembled by and are archived at the Regional Office. Almost all laboratories generated analytical data which were suitably compatible with other laboratories. The larger laboratories that generated the bulk of the data uniformly demonstrated the best compatibility. Most laboratories consistently demonstrated adequate recoveries on reference and spike materials in samples, and when a difficulty was found, remedial action was taken. The analyses of the blind field replicate samples demonstrated that sampling and analytical integrity had been adequately maintained to provide useful data for PLUARG studies. From all the various studies in the Quality Assurance Program, only two laboratories demonstrated analytical difficulties much of the time. Appropriate steps were taken to ensure that the findings from the studies supported by these laboratories did not affect the conclusions of the Task C Work Group.

The Quality Assurance Program was able to demonstrate that overall laboratories were able to produce analytical data which were adequate for the PLUARG Task C Watershed Studies. The program was successful in removing identified analytical difficulties in all but two laboratories. Appropriate steps were taken to ensure that data derived from the two laboratories did not affect the conclusions of the Task C Work Group. The program established that sampling procedures, sample handling and analyses were in control by use of field sample replicates (unidentified to the laboratory). Only 5% of the replicate results were not withing acceptable ranges.

The program confirmed that laboratories producing the most data for the Watershed Studies also produced the most compatible data.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

74. DURHAM, R.W. and JOSHI, S.R.
1981: Sedimentation Rates in Western Nipigon Bay, Lake Superior Using the $^{210}Pb$ Method; Science of the Total Environment, Vol. 22, No. 1, p. 51-59.

ABSTRACT:

$^{210}Pb$, $^{226}Ra$ and $^{137}Cs$ profiles have been measured for sediment cores from three locations in western Nipigon Bay, Lake Superior, Canada. Compaction of the sediment with depth of burial was taken into account in calculation recent sedimentation rates and age profiles at these locations from the excess $^{210}Pb$ profiles. The rates at two of the locations were 0.85±0.03 mm $y^{-1}$ (16.7 mg $cm^{-2}y^{-1}$) and 1.39±0.12 mm $y^{-1}$ (29.5 mg $cm^{-2}$ $y^{-1}$). The third core had an anomaly in the $^{210}Pb$ profile below a depth of 3.5 cm corresponding to the time that the outfall of a nearby pulp mill was relocated. The $^{137}Cs$ profiles of the two undisturbed cores were in accord with the corresponding age/depth curves derived from the $^{210}Pb$ measurements.

DATA:

Primary Source.

75. DURHAM, R.W. and JOSHI, S.R.
1984: Lead-210 Dating of Sediments from Some Northern Ontario Lakes; In: Quaternary Dating Methods, W.C. Mahaney, editor, Elsevier Science Publishers, Amsterdam, p.75-85.

SUMMARY:

Sedimentation rates were determined for 14 Ontario lakes including Batchawana (identified as upper headwater in the report); Little Turkey and Turkey Lakes in the Turkey Lakes Watershed. Both $^{210}Pb$ and $^{137}Cs$ techniques were used to established the sedimentation rates which ranged from 0.67 (Turkey L.) to 0.96 mm $yr^{-1}$ (Batchawana L.). A detailed description of the radiometric dating technique (calculations) is given.

DATA:

Primary Source.

76. EAGER, R.J.
1975: Bank Erosion on Wilton Creek in Southeastern Ontario; Unpublished M. Sc. Thesis, Department of Geography, Queen's University, Kingston, 235 p.

ABSTRACT:

Little research has been conducted on bank erosion in an area with extensive frost action during the winter months. This study with the use of stereophotography and bank staking has examined the erosional processes, times of erosion, and amounts of erosion along Wilton Creek in Southeastern Ontario.

The study was conducted from mid-November 1973 to September 31, 1974. Stereophotography was conducted at selected sites in mid-November 1973 and mid-May 1974. The banks were staked at the end of November 1973 and the amount of erosion occurring was recorded April 31, 1974, May 31, 1974 and September 30, 1974.

Soil samples were taken from the staked areas in order to correlate the amounts eroded with the particle size distribution and liquid and plastic limits of the bank material. The results indicated that there was a relationship between these soil parameters and bank erodibility but that other factors such as the bank's position on the creek, vegetation, and bank height also affected the erosion rates.

It was found that virtually all of the erosion on Wilton Creek occurred during the spring melt when the ice breaks up. Little erosion occurs during the summer and winter months.

The erosional processes operating on the riverbanks were numerous and the evidence collected indicates that no one erosion process dominates. Direct water shear, frost action, ice movement, and ice shear were probably the major erosional processes operating on the creek. Secondary erosional processes include dessication, water seepage, and bank slumpage.

In conclusion this short study indicates the major parameters affecting the method, time, and rate of erosion of the riverbanks on the Wilton Creek watershed.

DATA:

Primary Source.

77. EL-SHAARAWI, A., ESTERBY, S.R., WARRY, N.D. and KUNTZ, K.W.
1985: Evidence of Contaminant Loading to Lake Ontario from the Niagara River; Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 7, p. 1278-1289.

ABSTRACT:

The hypothesis that the concentrations of pollutants are the same throughout the length of the Niagara River, against the alternative that they are higher in the lower river, was examined using three sets of data: (1) Ontario Ministry of Environment's (MOE) results for organic substances in raw drinking water (1978-84); (2) MOE transect data for metals in water (1981); (3) Environment Canada data on organic substances on large-volume water samples and suspended sediments (1981). The designs of the studies dictated different statistical procedures for each set, with nonparametric procedures based on ranking being used for sets 1 and 3, and normal theory methods for set 2. Further, both univariate and multivariate procedures were used for set 3.

Despite the considerable number of nondetections in these data, it was still possible to make quantitative comparative statements, with the degree of uncertainty providing the quantitative component. In each study, a number of substances were shown to be higher in the lower river than in the upper river, and by examining all substances of set 3 simultaneously, locations in the lower river were shown to be similar to each other as were locations in the upper river.

DATA:

Secondary Source; refer to Ontario Ministry of Environment and Water Survey of Canada data.

78. ENVIRONMENT CANADA
1971: Conestogo Reservoir (1969) Sedimentation Survey; Joint Report, Inland Waters Branch, Water Survey of Canada, Sediment Survey Section and Conservation Authorities Branch, Department of the Environment of Ontario, 13p.

ABSTRACT:

The 1969 Sediment Survey of the Conestogo Reservoir was the first of a series of surveys to be conducted at the reservoir. The purpose of the surveys was to obtain sufficient data upon which to base an evaluation of sedimentation rates and the effects of sedimentation on reservoir storage.

During the course of the 1969 survey, forty-eight cross-sections were established and their profiles surveyed, and bed-material sampling and suspended sediment sampling was carried out. The results of the survey are presented in tabular and graphic form in Appendices III and IV.

The report sets out a number of recommendations for the conduct of future surveys of the Conestogo Reservoir, based upon experience gained during the 1969 survey.

DATA:

Primary Source.

79. ENVIRONMENT CANADA
1972: Parkhill Reservoir, Sedimentation Survey; Joint Report, Inland Waters Branch, Water Survey of Canada, Sediment Survey Section and Conservation Authorities Branch Department of the Environment of Ontario, 27p.

ABSTRACT:

The 1970 Sediment Survey of the Parkhill Reservoir is described in this report.

This was the first of a series of at least three surveys which are to be conducted at this reservoir. Thirty-seven cross-sections were established within the reservoir and their profiles were surveyed. Sampling of bed material and suspended sediment was also carried out during the survey. The survey results are illustrated by tables and graphs in the Appendices of the report.

Recommendations include a plan for subsequent surveys of the reservoir and an extension of the present study to include the entire watershed area. The former should provide sufficient data to enable evaluation of the rate of sedimentation and its effects on reservoir storage. The latter will produce a relationship between watershed properties and sediment production from the watershed.

DATA:

Primary Source.

80. ENVIRONMENT CANADA
1973: Fanshawe Reservoir, 1972. Sedimentation Study; Joint Report, Inland Waters Branch, Water Survey of Canada, Sediment Survey Section and Conservation Authorities Branch, Ontario Ministry of Natural Resources, 28p.

ABSTRACT:

The 1972 Sediment Survey of the Fanshawe Reservoir is described in this report.

This was the first of a series of at least three surveys which are to be conducted at this location, the purpose of which is to compute the reservoirs's sedimentation rate and hence its life expectancy. Thirty-one cross-sections were established within the reservoir and their profiles were surveyed. Sampling of bed material and suspended sediment was also carried out during the survey. The survey results are illustrated by tables and graphs in the Appendices of the report.

Recommendations include a plan for a subsequent resurvey of selected reservoir ranges which will be used to determine if a complete resurvey is required and an outline of methods used to determine densityies of the deposited sediment. The volumetric accumulation rates and density patterns will form the basis in determining the overall reservoir sedimentation rate and therefore anticipated reservoir life.

DATA:

Primary Source.

81. ENVIRONMENT CANADA
1975: Belwood Reservoir, 1971. Sedimentation Study; Joint Report, Inland Waters Branch, Water Survey of Canada, Sediment Survey Section and Conservation Authorities Branch, Ontario Ministry of Natural Resources, 29p.

ABSTRACT:

The 1971 Sediment Survey of the Belwood Reservoir is described in this report.

This was the first of a series of at least three surveys which are to be conducted at this reservoir. Thirty-three cross-sections were established within the reservoir and their profiles were surveyed. Sampling of bed material and suspended sediment was also carried out during the survey. The Survey results are illustrated by tables and graphs in the Appendices of the report.

Recommendations include a plan for subsequent surveys of the reservoir and an outline of methods to be utilized for determining densities of the deposited sediment. The computed density patterns and volumetric accumulation rates will form the basis for estimating sedimentation rates within all sections of the reservoir. This information should help pinpoint future problem areas thereby enabling preventive measures to be taken in some cases. Additionally the above sectional sedimentation rates will determine the overall reservoir sedimentation rate and therefore anticipated reservoir lifetime.

DATA:

Primary Source.

82. ENVIRONMENT CANADA
1975: Supplement to Fanshawe Reservoir, 1972. Sedimentation Study; Inland Waters Directorate, Water Survey of Canada, Sediment Survey of Canada and Conservation Authorities Branch, Ontario Ministry of Natural Resources, 6p.

ABSTRACT:

This is a supplement to the Fanshawe Reservoir 1972 Sedimentation Study.

It was impossible at this time, due to reservoir conditions, to actually re-survey the reservoir. Therefore, photographs and bed material samples were taken at various locations in an attempt to show how conditions had changed since 1972.

It is from these photographs and sample analysis that the conclusions have been formulated.

DATA:

Primary Source.

83. ENVIRONMENT CANADA
1977: South Nation River. Sedimentation and 1971 Landslide Studies; Joint Report, Inland Waters Directorate, Water Survey of Canada and Conservation Authorities Branch, Ontario Ministry of Natural Resources, 17p.

ABSTRACT:

This report contains a description of the physiography, survey procedure and survey results on a 26 (twenty-six) mile length of the South Nation River between Casselman and the Ottawa River.

In May of 1971, a large slide occurred along the South Nation River approximately four miles north of Casselman. The material which slumped into the river dammed the main channel for a period of several months. The opening of a new channel resulted in the degradation of the recent deposits at the slide and subsequent deposition of this material in areas of lower velocities downstream of the slide site.

The purposes of this survey were to obtain sufficient data upon which to base an estimation of the volume of earth moved during the slide and to do the ground work required to prepare for subsequent surveys in an attempt to evaluate the sedimentation rate in the channel.

The survey consisted of planning, establishing and profiling 29 (twenty-nine) equally spaced ranges. Bed and bank material samples were collected across each range and suspended sediment samples were collected at three different locations along the stretch of the river. The survey results are illustrated by tables and graphs in the Appendices of the report.

Recommendations include a plan for possible subsequent resurveys of the river based upon experience gained during the 1973/1975 survey. These data should provide sufficient information for an evaluation of the conditions concerning present rates of erosion and deposition.

DATA:

Primary Source.

84. ENVIRONMENT CANADA
1980: Historical Sediment Data Summary Canadian Rivers to 1978; Biennial Publication, Inland Waters Directorate, Water Resources Branch, Water Survey of Canada, 121p.

ABSTRACT:

The first edition of a new publication series titled Historical Sediment Data Summary for Canadian Rivers was produced for data to

1974. This publication contains a summary of historical monthly and annual mean suspended sediment load, and annual extremes of daily suspended sediment concentration and loads and total annual suspended load. Commencing with the 1978 publication, data are presented entirely in the International System of Units (SI).

DATA:

Primary Source.

85. ENVIRONMENT CANADA
1984: Sediment Data Reference Index Canada 1982; Biennial Publication; Inland Waters Directorate, Water Resources Branch, Water Survey of Canada, 47p.

ABSTRACT:

The first edition of a Sediment Data Reference Index was published for data to 1972. It contains a tabulation of locations where sediment data in Canada were collected by the Water Survey of Canada. The index has been subdivided alphabetically by province or territory, with sediment survey stations listed alphabetically. Commencing with the 1978 publication, data are presented in the International System of Units (SI) and will continue to be published biennially.

DATA:

Primary Source.

86. ENVIRONMENT CANADA
1985: Sediment Data Canadian Rivers 1983; Annual Publication, Inland Waters Directorate, Water Resources Branch, Water Survey of Canada, 233p.

ABSTRACT:

This paper contains data on streamflow, daily suspended sediment discharges, daily mean suspended sediment concentration, particle-size distribution of bedload, and water temperature for days sediment samples were collected for the Calendar year 1983.

NOTE: During the years 1948 to 1960, some sediment data were collected for several Prairie rivers to meet the needs of particular projects. The first paper containing sediment data incorporates a selection of these data and also data for part of the year ending September 30, 1961 at stations established for the continuing program. The second issue is a biennial publication covering only the continuing program for the 1962 and 1963 water years. All subsequent editions titled Sediment Data Canadian Rivers were published

annually. Commencing with the 1978 publication, data are presented entirely in the International System of Units (SI).

DATA:

Primary Source.

87. ENVIRONMENT CANADA
1986: Sediment Data Ontario 1984; Annual Publication, Inland Waters Directorate, Water Resources Branch, Water Survey of Canada, 69p.

ABSTRACT:

This publication contains data on streamflow, instantaneous suspended sediment concentration; daily means suspended sediment concentration; daily suspended sediment loads; dissolved solids concentration; load summary; particle-size distribution of suspended sediment in percent sand, silt and clay; bed load and bed material; water temperature when samples were collected; type of sampler and the single sampling vertical location.

DATA:

Primary Source.

NOTE:

Commencing with 1984, the Sediment Data are presented and published in a new format wherein Canada is divided into eight regions. The provinces each represent a separate region except for New Brunswick, Newfoundland, Nova Scotia and Prince Edward Island, which together form the Atlantic Provinces region, and the Yukon and Northwest Territories which make up another. The publications are identified by the province or territories covered and the year in which the data were collected. These data are published annually on a calendar-year basis and the stations are listed alphabetically.

88. ENVIRONMENT CANADA - ONTARIO MINISTRY OF THE ENVIRONMENT
1985: St. Clair River Pollution Investigation (Sarnia Area); Joint Report of the Review Board of the Canada-Ontario Agreement Respecting Great Lakes Water Quality, 135p.

ABSTRACT:

On August 13 to 16, Dow Chemical Canada Inc., Sarnia, Ontario, experienced mechanical valve problems, causing a spill of approximately 9400 gal (42 300 L) of perchloroethylene, a toxic dry cleaning solvent of which approximately 2500 gal (11 000 L) reached the St. Clair River. Approximately two thousand gallons were immediately recovered by DOW. This spill, combined with the

discovery in 1984 and 1985 of a black tarry substance in the river overlying the sediment, led the Ministers of the federal Department of the Environment (DOE) and the Ontario Ministry of the Environment (MOE) to initiate an investigation into the nature and extent of contamination. This investigation was carried out under the auspices of the Canada-Ontario Agreement Respecting Great Lakes Water Quality.

DATA:

Primary Source.

89. EVANS, R.D.
1980: Measurement of Sediment Accumulation and Phosphorus Retention Using Lead-210 Dating; Unpublished Ph. D. Thesis, Department of Botany, McGill University, Montreal, 171 p.

ABSTRACT:

Lead-210 dating was used to measure rates of sediment accumulation in three lakes in the Haliburton area of Ontario. Approximately twenty cores were analyzed in each lake. The rates of accumulation were correlated with lake depth at the sample site. This relationship was used to calculate accumulation of sediment over the whole lake area. The retention of phosphorus (P) in the sediment of each lake was calculated using the whole lake sediment accumulation, and mean P concentrations in the sediments. This P retention compared favourably with that previously measured by mass balance methods.

Total anthropogenic lead was measured in each lake. In a proposed method for simplifying the measurement of the average accumulation of the bulk sediments, the amount of anthropogenic lead in a core was used as an indicator of sediment movement. Predictions of average accumulation based on a single dated sediment core compared well with whole lake measurements.

DATA:

Primary Source.

90. EVANS, R.D. and DILLON, P.J.
1982: Historical Changes in Anthropogenic Lead Fallout in Southern Ontario, Canada; Hydrobiologia, Vol. 91/92, p. 131-137.

ABSTRACT:

A quantitative historical record of anthropogenic lead deposition has been determined for the Haliburton region of southern Ontario from a) the relative change in lead concentration in undisturbed sediment cores, and b) the total anthropogenic lead deposition

measured in the region. The first parameter was measured on two sediment cores from a meromictic lake. Total lead deposition was assumed to be the average of that measured for eight other lakes in the study area. The validity of this historical record was tested on sediment cores from nearby dimictic lakes. Predicted lead concentration profiles closely resembled observed profiles.

DATA:

Secondary Source; refer to Evans (1980).

91. EVANS, R.D. and RIGLER, F.H.
1980: Calculation of the Total Anthropogenic Lead in the Sediments of a Rural Ontario Lake; Environmental Science and Technology, Vol. 14, No. 2, p.216-218.

ABSTRACT:

Sediment cores from a rural Ontario lake (Bob Lake, latitude 44°55'N, longitude 78°47'W) were analyzed for total anthropogenic lead content. A high correlation between deposition of anthropogenic lead and sediment depth facilitated calculation of total fallout of anthropogenic lead in Bob Lake. The total fallout of 820 mg $m^{-2}$ is large for a rural area in comparison to that calculated for the Lake Michigan-Chicago area (390 mg $m^{-2}$).

DATA:

Secondary Source; refer to Evans (1980).

92. EVANS, R.D. and RIGLER, F.M.
1980: Measurement of Whole Lake Sediment Accumulation and Phosphorus Retention Using Lead-210 Dating; Canadian Journal of Fisheries and Aquatic Sciences, Vol. 37, No. 5, p.817-822.

ABSTRACT:

Lead-210 dating was used to measure rates of sediment accumulation in 15 cores from Bob Lake, Ontario. The rate of accumulation was highly correlated with sample depth. This relation allowed the calculation of accumulation of sediments over the whole lake area. Phosphorus (P) retention was calculated from mean concentration of P in the sediments and the whole lake accumulation of sediment. Retention of P calculated in this way was similar to retention calculated from previously measured input and output of P.

DATA:

Secondary Source; refer to Evans (1980).

93. EVANS, R.D. and RIGLER, F.H.
1983: A Test of Lead-210 Dating for the Measurement of Whole Lake Soft Sediment Accumulation; Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 4, p.506-515.

ABSTRACT:

We have tested the hypothesis that variation in accumulation of soft sediments over a lake bottom is related to the lake morphometry, allowing an accurate measurement of whole lake sediment accumulation. In each of two Laurential Shield lakes in southern Ontario, sediment accumulation was measured at ~20 locations. In both there was a statistically significant linear relationship between soft sediment accumulation and the water depth at the sample locations. The relationship explained 72 and 57% of sediment accumulation variation in Costello and Red Chalk lakes, respectively. Using these relationships, it was possible to calculate the whole sediment accumulation rate for each lake. The results indicate that, in general, there is a linear variation in sediment accumulation as a function of depth in small Shield lakes. This study points out the need for a closer examination of sediment movement and accumulation in the shallow regions of lakes.

DATA:

Primary Source.

94. EVANS, H.E., SMITH, P.J. and DILLON, P.J.
1983: Anthropogenic Zinc and Cadmium Burdens in Sediments of Selected Southern Ontario Lakes; Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 5, p.570-579.

ABSTRACT:

The concentrations of Cd and Zn were measured in the sediments of 10 softwater lakes in southern Ontario. Elevated Cd and Zn levels were present in the recently deposited sediments of all the lakes, despite the absence of local point-source inputs. Whole-lake anthropogenic Zn and Cd burdens, calculated by prorating site-specific burdens according to the ratio of the site-specific Pb burden to the whole-lake Pb burden, range between 322 and 617 $mg.m^{-2}$ for Zn and between 6.2 and 11.3 $mg.m^{-2}$ for Cd. There were no significant differences in anthropogenic Zn or Cd burdens between lakes. The lack of a relationship between Zn or Cd burdens and the ratio of watershed area to lake area or the water replenishment time of the lakes indicates that deposition from the atmosphere directly onto the lakes' surfaces is an important input of these metals to the lakes.

DATA:

Primary Source.

95. FALLON, M.E. and HORVATH, F.J.
1985: Preliminary Assessment of Contaminants in Soft Sediments of the Detroit River; Journal of Great Lakes Research, Vol. 11, No. 3, p. 373-378.

ABSTRACT:

Soft sediments from the Detroit River were analyzed for the USEPA priority pollutants to generally characterize contaminant distribution. Forty-three were detected. Highest heavy metal concentrations were found in the Trenton Channel and immediately downstream of Grosse Ile. They ranged from an area mean (N=2) of 0.19 mg/kg mercury to 338.7 mg/kg zinc (dry weight). Polynuclear aromatic hydrocarbons ranged from 0.1 mg/kg to 38.8 mg/kg (mean, N=2) with the highest levels near Grosse Ile. PCBs ranged from 0.015 mg/kg to 1.7 mg/kg (mean, N=2). Organochlorine pesticides were not detected except for a trace of heptachlor in one sample. Sediment contamination in the Detroit River is widespread with higher concentrations on the U.S. side downstream of the Rouge River and in the Trenton Channel. The significance of these in-place pollutants to biota and as a source to Lake Erie is still unknown.

DATA:

Primary Source.

96. FEDERAL-PROVINCIAL TECHNICAL WORKING GROUP ON WATER QUALITY IN THE OTTAWA RIVER
1980: Report of the Contaminants Task Force of the Federal-Provincial Technical Working Group on Water Quality in the Ottawa River, 23p.

ABSTRACT:

This report on contaminants in the Ottawa River indicates, after examination of all available data, that a number of localized contaminant problems do exist although the river as a whole shows no sign of unusual contamination. It is found that: no problems exist with respect to trace metals contamination; PCBs are present in the river ecosystem; although no problem exists for acid rain from Lake Temiskaming to the south, the status of the Ottawa River north of the lake is at present undetermined; and, no problem presently exists with respect to radionuclide contamination of the river. Data on the presence of trace metals and persistent organic contaminants in water, sediments, biota and fish are presented. A brief account on the effects of acid rain on the Ottawa River basin is also included.

DATA:

Secondary Source; refer to Oliver (1973), Oliver and Agemian (1974) and Oliver and Kinrade (1972).

97. FEDERAL-PROVINCIAL TECHNICAL WORKING GROUP ON WATER QUALITY IN THE OTTAWA RIVER
1981: Report of the Federal-Provincial Technical Working Group on Water Quality in the Ottawa River, 29p.

ABSTRACT:

The Federal-Provincial Technical Working Group on Water Quality in the Ottawa River reviewed nutrients, contaminants and bacteriology as they impact on the water quality conditions of the river. Although no major problems were discovered, deterioration of water quality in localized areas was recognized. In many instances, however, a lack of consistent, reliable data made it impossible to reach a definite conclusion as to the presence and significance of some contaminants. Significant decreases in phosphorus concentrations between 1972 and 1976 were recorded, due in large part to the effect of detergent phosphate limitations and to phosphorus removal in Ontario sewage treatment plants. Dissolved oxygen concentrations are generally acceptable. There have been decreases with time at Carillon and particularly at the Otto Holden Station. The rather sparse data on the trace metals and organics did not reveal any serious problems other than the well-documented presence of mercury which appears to be slowly diminishing, and possible elevated levels of PCB's downstream of Ottawa. There is bacteriological contamination in the Ottawa region due to municipal discharges and urban storm water runoff. Generally, the bacteriological quality is better in midstream than in near shore areas. The evaluation of the water quality was hampered by gaps and inconsistencies in the data due to a lack of coordination of monitoring programs and the recent discontinuation of some of the monitoring. The Working Group recommends that a coordinating committee be established, with representation from the governments of Canada, Quebec and Ontario. The committee would be responsible for reviewing data needs and overseeing the implementation of a coordinated monitoring plan in accordance with the available resources of the three agencies and would report annually to the Environment Ministers of the three governments. The Working Group also recommends that dissolved oxygen monitoring be reviewed on a priority basis, that pollution abatement efforts be continued with emphasis on biochemical oxygen demand reduction, and that the effects of agricultural imputs be evaluated in a special study.

DATA:

Secondary Source; refer to Miller (1977) and Ontario Ministry of the Environment data.

NOTE:

This publication was also published in 1971 and 1977.

98. FEDERAL-PROVINCIAL TECHNICAL WORKING GROUP ON WATER QUALITY IN THE OTTAWA RIVER
1981: Report of the Monitoring Plan Task Force of the Federal-Provincial Technical Working Group on Water Quality in the Ottawa River; 24p.

ABSTRACT:

A monitoring plan which presents a basic framework for monitoring activities and is designed to provide the required information for the proper assessment of the water quality of the Ottawa River, is described. The plan presented determines the impact of man's activities on the quality of the river ecosystem in a coordinated and cost-effective manner which is required to meet the following objectives: determine existing water quality conditions; identify problem areas; assist managers in the design and implementation of remedial programs; and, determine water quality trends. The plan is carried out on the interprovincial section of the river between Dame-du-Nord and Carillon and is comprised of the following components: mainstem (water, sediment and fish); and, inputs (tributaries, municipal, industrial, and non-point sources). Sampling locations, frequencies and procedures, the use of standard methods of analysis, quality control programs and conformance in data storage, retrieval, verification, analysis and utilization, are included in the program.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

99. FINLAYSON, G.D.
1973: On the Distribution of Suspended Sediment in Transitional Regions; Unpublished Ph. D. Thesis, Department of Civil Engineering, Queen's University, Kingston, 99p.

ABSTRACT:

This thesis concerns the distribution of suspended sediment in open channels at the beginning of the movable bed. It is assumed that the granular material forming the movable bed is cohesionless and that the turbulent flow which can be treated as two-dimensional is stationary and uniform. It is supposed that the fluid is initially clear and that the suspended load is acquired as a result of the dynamic action of the flow on the movable bed.

The problem is treated theoretically be the differential equation of convective diffusion, where the vertical diffusivity is identified with the kinematic turbulent viscosity and the flow velocities are evaluated according to the logarithmic law.

The concentration distributions were obtained by solving this equation numerically. Since this equation involves the effective bed roughness, which for the case of a movable bed cannot be predicted accurately, it was not possible to obtain the concentration distributions on a purely theoretical basis. Thus in the present thesis the experimental measurements were conducted not only to verify the trends but also to determine the absolute aspects of the solutions.

Using the concentration distributions determined, the "development lengths" were computed, which may be used to reveal those distances downstream from the beginning of the movable bed, beyond which the concentrations corresponding to some specified levels remain virtually unchanged.

It is shown that the method presented can also be applied to the study of suspended load in sedimentation basins. Thus a new set of the design curves for the basin lengths is suggested.

DATA:

Primary Source.

100. FITCHKO, J.
1974: Heavy Metal Concentrations in River Mouth Sediments of the Great Lakes; Unpublished M.Sc. Thesis Department of Botany and Institute for Environmental Studies, University of Toronto, 132 p.

ABSTRACT:

Surface and core sediment samples, collected from the mouths of 116 watercourses flowing into the Great Lakes were analyzed for ten heavy metals. Considerable variation occurred from site to site and lake to lake in concentrations of individual metals. Certain sites were characterized by very elevated levels of one or more metals.

Most watercourses associated with urban-industrial activities had outlet sediments containing elevated concentrations of heavy metals. However, a number of watercourses with urban-industrial activity upstream contained outlet sediments with low concentrations of heavy metals. This seemed to be because of the deposition of the contaminants into glacial lakes and swamps ('sinks') located upstream from the river mouths. Also, most undeveloped watercourses were characterized by outlet sediments with low concentrations of heavy metals.

The concentrations of all the heavy metals studied were greater in the sediments of the Lower Great Lakes. This appears to correlate with the greater urban-industrialization in this region and relates to discharges into the rivers and waterways.

Most of the core samples in this study did not indicate surface accumulation of heavy metals. Instead there was either no pattern or a uniform distribution. These 'homogeneous' concentrations throughout the core were attributed to the resuspension, mixing and redeposition of sediments by dredging, shipping activity and current action. Dredging and shipping activity probably act as agents for a significant input of heavy metals into the Great Lakes system by resuspension and physical deposition of fine particles. A small number for cores taken in undisturbed sediments (ie. at outlets of watercourses not dredged) were characterized by surface accumulation of heavy metals.

The lotic inputs of silt (suspended sediment) were greater in the Lower Great Lakes. This was due primarily to the agricultural and urban-industrial specialization and the natural geology (soil and rock types) featured around this region.

The concentration of heavy metals in the outlet sediments of tributaries can be related to numberous input factors and to sediment characteristics including binding and retention mechanisms. Because the study area was so large and diverse, these factors differed sharply from one watercourse to another. Yet, significant correlations were found between the concentrations of several heavy metals and the loss on ignition (organic matter) data and with the clay fraction of the sediment.

There was a great variability in the heavy metal concentrations in contiguous sediments on both vertical and horizontal planes.

While it is not claimed that each value given in the text is even as accurate as ±10%, the data appear to be valid on a comparative basis.

Regular Ekman grab and core sampling of sediment, especially in watercourses where high metal concentrations were obtained, would be useful in following any seasonal or annual changes in metal concentrations that may be occurring.

A more extensive study of the distribution of heavy metals in specific lotic environments could provide insights as to the specific sources (industrial or otherwise), pathways, binding and retention mechanisms, and biological and geochemical interactions of heavy metals.

DATA:

Primary Source.

101. FITCHKO, J. and HUTCHINSON, T.C.
1975: A Comparative Study of Heavy Metal Concentrations in River Mouth Sediments around the Great Lakes; Journal of Great Lakes Research, Vol. 1, No. 1, p.46-78.

ABSTRACT:

Surface and core samples of sediment from the mouths of 116 watercourses flowing into the Great Lakes system have been analyzed for ten heavy metals (lead, silver, cadmium, cobalt, copper, chromium, nickel, zinc, manganese and mercury).

Most 'undeveloped' watercourses, especially those in Lakes Superior and Huron, are characterized by outlet sediments with low concentrations of heavy metals. Elevated levels of heavy metals occur in the outlets of most watercourses with urban-industrial activities, with the exception of those tributaries on the eastern side of Lake Michigan with glacial lakes and swamps upstream which act as sedimentation 'sinks' for heavy metals. Watercourses with elevated and excessive levels of heavy metals in their outlet sediments are identified.

Most of the core samples showed no surface accumulation of heavy metals, probably due to dredging, shipping activities and current action in the river outlets.

The lotic inputs of all the heavy metals studied, especially cadmium, chromium and mercury, are greater in the Lower Great Lakes than in the Upper Lakes.

A number of significant correlations were found between the heavy metal concentrations and two of the sediment parameters, i.e., clay content and percentage loss in ignition (organic matter).

DATA:

Secondary Source; refer to Fitchko (1974).

102. FOK, A.T.K., VATAGODAKUMBURA, S. and BISHOP, C.J.
1979: On the Estimation of Scour Depth in a Channel Outlet; Proceedings of the Fourth National Hydrotechnical Conference on River Basin Management, Canadian Society for Civil Engineering, May 7-8, 1979, p. 412-427.

ABSTRACT:

A practical engineering application of sediment transport equations to the prediction of scour depth at a channel outlet is demonstrated. In the course of designing a channel outlet with vertical sheet pile walls in alluvial material, an invert elevation safe from scour had to be determined. A method has been devised for estimating scour resulting from a storm: sediment transport equations are applied to each time increment of the discretized design storm hydrograph. The sensitivity of predicted scour depth to the initial flow depth, the peak flow and duration of the design hydrograph, and the choice of sediment transport equation has been investigated.

DATA:

Primary Source.

103. FORTESCUE, J.A.C.
1971: A Preliminary Study of the Use of Stream Sediment Geochemistry to Detect the Effects of Man's Activities on the Environment Around St. Catharines, Ontario; Brock University, Department of Geological Sciences, Research Report Series No. 2, Studies in Landscape Geochemistry No. 1, 22p.

SUMMARY

This report includes a preliminary description and interpretation of the geochemical maps with particular reference to the possible use of stream sediments as a guide to the measurement of the effect that man has had on the chemistry of the environment.

DATA:

Primary Source.

104. FORTIN, M., BACCHUS, A. and POST, L.
1983: Impact of Stratford City Impoundments on Water Quality in the Avon River; Technical Reports S-1, Stratford/Avon River Environmental Management Project, 26p.

ABSTRACT:

As part of the Stratford-Avon River Environmental Management Project, the Southwestern Regional Office of the Ontario Ministry of the Environment collected data on water chemistry and sediments at 13 stations along the Avon River during 1980 and 1981. In addition, the River Systems Unit of the Water Resources Branch, MOE, conducted an intensive in-lake survey of Lake Victoria in August 1980. Data from these surveys and other sources were used to assess the impact of Lake Victoria and the John Street weir impoundment on the water quality of the Avon River. The analysis focussed on summer impacts (May to September) since this is the period of greatest concern in this study and since the impoundments have in the past been drawn down over the winter period.

Major influences of the impoundments include increases in $BOD_5$ and reduction in dissolved oxygen (DO) concentrations, increases in total phosphorus and TKN, decreases of soluble phosphorus, increases in suspended solids, increases in zinc concentrations and a reduction of fecal coliform and fecal streptococci bacteria. Some of the processes that may underlie these influences are phytoplankton production, weir de-aeration, contamination from storm-sewer flows and assimilation or decay. An analysis of sedimentation rates revealed that Lake Victoria is very likely an efficient trap for suspended mineral sediments. The observed increase in suspended sediments in flows leaving the lake may therefore be caused by organic debris originating in the lake. From an analysis of bottom sediments, it was found that

Lake Victoria sediments display some heavy metal contamination likely related to urban runoff.

DATA:

Primary Source; also refer to Ontario Ministry of the Environment data.

105. FOX, M.E., CAREY, J.M. and OLIVER, B.G.
1983: Compartmental Distribution of Organochlorine Contaminants in the Niagara River and the Western Basin of Lake Ontario; Journal of Great Lakes Research, Vol. 9, No. 2, p. 287-294.

ABSTRACT:

Ten chlorobenzenes, hexachlorobutadiene, and PCBs were measured in Niagara River water and suspended solids, and in western Lake Ontario sediments and benthic fauna. High levels of these contaminants were found on all fractions of the river suspended solids, but the larger particles contained much higher concentrations than the smaller particles. A portion of the CBs, HCBD, and PCBs present in the lake sediments was available to benthic organisms. A trend toward greated bioaccumulation for compounds having higher octanol-water partition coefficients was observed at all trophic levels.

DATA:

Primary Source.

106. FRANK, R.
1976: Anthropogenic Influences of Sediment Quality at a Source. Pesticides and PCB's; Proceedings of the Workshop on the Fluvial Transport of Sediment - Associated Nutrients and Contaminants, H. Shear and A.E.P. Watson, Editors, October 20-22, 1976, Kitchener, p. 73-80.

ABSTRACT:

The author presents preliminary results of the analysis of samples of suspended solids collected at the river mouths of watercourses on the Canadian side of the Great Lakes between 1974 and 1976. A list is given of those pesticides found in the suspended solids collected.

DATA:

Primary Source.

107. FRANK, R.
1981: Pesticides and PCB in the Grand and Saugeen River Basins; Journal of Great Lakes Research, Vol. 7, No. 4, p.440-454.

ABSTRACT:

The Grand and Saugeen rivers drain two major basins in the Province of Ontario. Information is presented on pesticide use and losses of pesticides and PCB into these two river systems and their delivery to the Great Lakes. Pesticides were divided into persistent (those that persisted from one season to the next) and non-persistent. Members of both categories appeared in upstream waters; however, only the former appeared at the mouth. Non-persistent pesticides found in the system occurred at the time of spraying or shortly thereafter in storm runoff waters but not at other times.

Persistent pesticides found in the system included those that had been discontinued (i.e. dieldrin and DDT and metabolites) and those in use throughout the study period (i.e., chlordane (and heptachlor epoxide), atrazine, and simazine). All six compounds were identified in water or on suspended solids throughout the year.

Atrazine was the most widely used pesticide in the basins and loadings a the mouth appeared to be 0.6% of that applied. Loadings of chlordane and heptachlor epoxide at the mouth suggested that greater inputs were coming from uses. PCB, an industrial chemical, was ubiquitous in the two basins and losses as measured at the river mouths were on the order of 30-40 and 7-10 kg/yr for the Grand River and Saugeen River watersheds, respectively. No residues of mirex were detected in either systems.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

108. FRANK, R., ARMSTRONG, A.E., BOELENS, R.G., BRAUN, H.E. and DOUGLAS, C.W.
1974: Organochlorine Insecticide Residues in Sediment and Fish Tissues, Ontario, Canada; Pesticides Monitoring Journal, Vol. 7, No. 3/4, p. 165-180.

ABSTRACT:

River and lake sediments and several species of fish were collected from four study areas in the Province of Ontario. These consisted of one agricultural, two mixed agricultural - recreational, and one recreational study area. Large volumes of DDT and dieldrin were used in the first area, small quantities were used in mixed areas, and insignificant quantities were used

in the recreational area. The agricultural and mixed area were located on deep alluvial soils; the recreational area was located on deep alluvial soils; the recreational area was located on bare-to-thinly-covered Precambrian rock. Residue levels in sediments were similar in all four areas, but slightly higher in the recreational area. The ratios of DDT to its metabolites, DDE and TDE, were similar in all areas in that the metabolites predominated over the parent DDT. Residues of DDT and dieldrin in fish tissues tended to depend on feeding habits, fat content, and age of the fish. Residues in the sediment (dry weight) were almost the same as residues found in the low-fat benthic invertbrate and plankton feeders.

Residues increased in the low-fat piscivores, were slightly higher in the high-fat feeders, and were highest in the high-fat piscivores. The concentration of DDT and dieldrin in the tissues and extractable fat and the actual quantity accumulated per fish increased as size and weight of any one species increased. The increase in total DDT or dieldrin concentration from lowest to highest tissue residues of all fish species was of the order of 100 to 500 times; the increase in body load was of the order of $10^3$ to $10^4$. Higher concentrations in fish tissue were correlated with the higher sediment levels of the Precambrian recreational area. Data demonstrate that the use of even minute quantities of persistent hydrocarbons in rocky Precambrian watersheds has a profound effect on sediment and biota contaminants. Use on deep rich soils has a similar effect, but not in the same proportion to the quantity used.

DATA:

Primary Source.

109. FRANK, R., BRAUN, M.E. and HOLDRINET, M.V.H.
1981: Residues from Past Uses of Organochloringe Insecticides and PCB in Waters Draining Eleven Agricultural Watersheds in Southern Ontario, Canada, 1975-1977; The Science of the Total Environment, Vol. 20, No. 3, p. 255-276.

ABSTRACT:

Between May, 1975 and April, 1977 eleven agricultural watersheds ranging in size between 19 and 79 $km^2$ were studied for residues of persistent organochlorine insecticides and PCB. Stream water, rainwater, sediments, invertebrates and fish were analysed. The presence of DDT, its metabolites and dieldrin, insecticides that had been removed from field application between 1969 and 1972, and PCB, an industrial fire retardant that had been voluntarily restricted to 'closed system' use in 1971, were identified.

ΣDDT was present in 93% of 949 initial stream waters and 40.6% exceeded a 3 ng/l International Joint Commission (IJC-1977) water quality objective for boundary waters of the Great Lakes. Unit area loading for ΣDDT ranged from 2.9 to 88 mg/ha/yr per watershed. Dieldrin was present in one-fifth of stream waters and 16% exceeded the 1 ng/l IJC (1977) objective. Unit area loading for dieldrin varied from zero to 28 mg/ha/yr per watershed. PCB residues were detected in 94.4% of stream waters at or above 2 ng/l and unit area loading varied from 28 to 269 mg/ha/yr per watershed.

DDE and PCB were found in rainwater and this could represent a major source of contamination of PCB. The soil reservoir was the main source of DDT and dieldrin. Accumulations of all three organochlorine compounds in invertebrates and fish were between $10^3$ and $10^4$ times. None of the fish or invertebrates exceeded the IJC objective of 0.1 µg/g PCB.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data and Coote et al. (1978).

110. FRANK, R., HOLDRINET, M., BRAUN, H.E., THOMAS, R.L, KEMP, A.L.W. and JAQUET, J.M.
1977: Organochlorine Insecticides and PCB's in Sediments of Lake St. Clair (1970 and 1974) and Lake Erie (1971); The Science of the Total Environment, Vol. 8, NO.3, p.205-227.

ABSTRACT:

Sediments were collected on a grid from Lake St. Clair in 1970 and 1974 and from Lake Erie in 1971 and analysed for organochlorine insecticides and PCBs. Suspended solids were centrifuged from pumped water in the Detroit River in 1974. Residues of DDE, TDE and DDT were highest in sediment from the Western Basin (70.3 ppb) Lake Erie and lowest in sediment from Lake St. Clair (6.6 ppb in 1970 and 2.6 ppb in 1974). The Central and Eastern Basins of Lake Erie contained residues that fell about mid-way between these means. TDE was the predominant component of ΣDDT and was followed by DDE at approximately half this residue. While DDT represented the lowest component in lake sediments, it was the highest component in suspended solids from the Detroit River.

HEOD was present in the entire lake system but at only a fraction of the level of ΣDDT. The mean residue in Lake St. Clair was only 0.1 ppb while Lake Erie sediments contained 1-2 ppb. The highest mean residue (3.6 ppb) was in suspended solides in the Detroit River. Other organochlorine insecticides were only occasionally identified.

PCB residues in sediment were approximately 3 times higher than the total organochlorine insecticide residue, being highest in the Western Basin (252 ppb) and lowest in Lake St. Clair (19 ppb in 1970 and 10 ppb in 1974). The Detroit River and Central and Eastern Basins of Lake Erie had intermediate residues.

Residues in Lake St. Clair indicated a decline in ΣDDT, HEOD, and PCB residues between 1970 and 1974, and this coincided with the restrictions on the materials. A core sample from the Western Basin of Lake Erie indicated that ΣDDT, HEOD and PCB began to accumulate in sediments in 1958, 1953, and 1956 respectively. This appeared to indicate a lag period of 2-5 years after wide-spread use occurred.

DATA:

Primary Source.

111. FRANK, R., MONTGOMERY, K., BRAUN, H.E., BERST, A.H. and LOFTUS, K. 1974: DDT and Dieldrin in Watersheds Draining the Tobacco Belt of Southern Ontario; Pesticides Monitoring Journal, Vol. 8, No. 3, p. 184-201.

ABSTRACTS:

Production of flue-cured tobacco in Ontario is concentrated mainly in four watersheds adjacent to Norfolk County on the north shore of Lake Erie, where tobacco is raised on a sandy loam soil using a 2- to 3-year rotation with cereals and corn. In 1961-69 an average amount of 4.4 kg/ha. DDT was used to control soil and foliar insects attacking tobacco. In 1970-71, DDT was restricted to the control of soil insects only; applications averaged 1.7 kg/ha. Residue data from soil samples collected in 1971 indicated total levels of 325,000 kg ΣDDT and 14,000 kg dieldrin in the entire tobacco-growing area. These residues represented 37 percent of the total DDT application to the area since 1961, and were calculated to agree with the half-life disappearance of 3-4 years.

Residue analysis of the tobacco crop in 1971 (42 million kg cured leaf) revealed that 52.6 kg ΣDDT and 1.97 kg dieldrin had been removed from the soil. This represents 0.18 percent of the DDT applied in 1971 or 0.03 percent of the ΣDDT and dieldrin resident in the soil the same year. corn silage and hay were calculated to contain 38.8 kg DDT and 0.76 kg dieldrin, but these residues remained in the watershed because the crops were used as feed for livestock. Animal products leaving the watershed in 1971 amounted to 54 million kg milk and 6 million kg meat which contained only 0.995 kg ΣDDT and 156 g dieldrin.

Total water discharging into Lake Erie from the four watersheds was calculated to carry 12.6 kg ΣDDT and 0.86 kg dieldrin in the

water and on suspended sediments, representing 0.002 percent and 0.03 percent, respectively, of the ΣDDT and dieldrin resident in the four watershed soils.

Fish species caught in Big and Dedrich Creeks contained residues 4 to 15 times higher than those of species from Long Point Bay and Lake Erie, reflecting the rapid dilution of the creek waters within 3 miles of the mouths of these creeks. Lowest pesticide concentrations in fish were about the same as the concentrations in water-suspended sediments. Magnification observed from water to the highest concentrations in large fish was approximately $10^5$; however, the tissue residue did not exceed the 5 ppm tolerance established in fish.

Residues in air appeared to be the result of either spray drift or airborne soil particles rather than volatilization from the soil.

DATA:

Primary Source.

112. FRANK, R. and SIRONS, G.J.
1979: Atrazine: Its Use in Corn Production and Its Loss to Stream Waters in Southern Ontario, 1975-1977; The Science of the Total Environment, Vol. 12, No. 3, p.223-239.

ABSTRACT:

In a farm-to-farm survey of 11 agricultural watersheds averaging 4279 ha, it was found that on average 18% of the watersheds were devoted to corn production and 73% of this production was treated with atrazine at a mean rate of 1.7 kg/ha.

Flow volumes in the 11 streams were gauged and waters were monitored for atrazine and its metabolite desethylatrazine between May 1975 and April 1977. These two compounds were detected in 80% of the stream waters at a mean concentration of 1.4µg/l. Seasonal variations in concentration were observed. Peak residues occurred in streams shortly after the main spray period and after a secondary fall spray period. During the winter season, concentrations declined below 1 µg/l.

Losses of applied atrazine were greatest on clay and least on sandy soils. The highest losses (60%) were caused by storm runoff events and especially in the January to April period. Spills accounted for 20% of the atrazine loss and the major period when this occurred was May to August. Losses due to base flow associated with drainage accounted for 20% and varied little over the year.

DATA:

Primary Source; also refer to Frank and Ripley (1977) and Coote *et al*. (1978).

113. FRANK, R. and SIRONS, G.J.
1980: Chlorophenoxy and Chlorabenzoic Acid Herbicides: Their Use in Eleven Agricultural Watersheds and Their Loss to Stream Waters in Southern Ontario, Canada, 1975-1977; The Science of the Total Environment, Vol. 15, No. 2, p. 149-167.

ABSTRACT:

A survey in 1975 of eleven agricultural watersheds revealed that chlorophenoxy (CPOA) and chlorobenzoic acid (CBA) herbicides were used for weed control in cereals, corn, peas and beans on farm land and along right-of-ways and other sites on non-agricultural land. These land uses represented 52.6% of the eleven watersheds and 31.8% of this area received treatments of CPOA and CBA herbicides. The quantities and areas treated with chloramben, 2,4-D, 2,4-DB, dicamba, MCPA, mecoprop and 2,4,5-T were documented.

Analysis of 949 initial stream waters revealed residues of 2,4-D in sixty-six, 2,4,5-T in twenty-one, MCPA in six and dicamba in one. Losses to stream water were correlated to spray activity adjacent to streams especially where careless use of equipment or material contaminated the water. In addition, storm runoff waters carried herbicide residues to streams, especially when occurring close to the time of application. Spraying of right-of-ways involved spraying of ditch banks with the inevitable contamination of stream water. Losses to water represented 0.03% of agricultural uses and 0.5% of non-agricultural uses. Concentrations found in water were well below currently accepted water quality objectives and therefore posed no known hazard.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data and Coote et al. (1978).

114. FRANK, R., SIRONS, G.J., THOMAS, R.L. and McMILLAN, K.
1979: Triazine Residues in Suspended Solids (1974-1976) and Water (1977) from the Mouths of Canadian Streams Flowing into the Great Lakes; Journal of Great Lakes Research, Vol. 5, No. 2, p. 131-138.

ABSTRACT:

Forty-five suspended solids collected during 1974 and 1976 from 12 streams on the Canadian side of the Great Lakes contained no detectable residues of triazines to a limit of 0.05 µg/g. Of ninety-two stream waters sampled in July, 1977, 77% contained atrazine, 52% desethylatrazine, and 28% simazine above a detectable level of 0.03 µg/L. Mean concentrations of these three triazines in the 92 streams were 1.6m 0.3, and 0.2 µg/L respectively. The highest mean triazine residue occurred in those stream waters entering Lake Erie (4.0 µg/L); there was little difference in the mean concentrations of waters entering Lakes

Ontario (1.1 µg/L), St. Clair (1.3 µg/L), and Huron (1.4 µg/L). While triazine herbicides were found entering the Great Lakes there was no threat to water quality as defined by the objectives of the International Joint Commission.

DATA:

Primary Source.

115. FRANK, R., THOMAS, R.L., HOLDRINET, H., McMILLAN, R.K., BRAUN, H.E. and DAWSON, R.
1981: Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977; Journal of Great Lakes Research, Vol. 7, No. 4, p.363-381.

ABSTRACT:

Suspended solids were collected from 105 streams on the Canadian sie of the Great Lakes during snow melt and spring flow between 1974 and 1977. Analyses were performed for organochlorine and organophosphorus insecticides and three industrial chemicals. All streams sampled contained suspended solids that were contaminated with DDT, its metabolites, and polychlorinated biphenyl (PCB). The highest mean concentrations of ΣDDT (356 µg/kg) occurred in 1974 from streams draining the Niagara Peninsula and entering Lake Ontario these were correlated to areas of high use on fruit in the past. The highest loadings by lake section, however, were along the north shore of Lake Erie involving a very much larger delivery of suspended solids. The highest concentrations of PCB were on suspended solids entering Lake Ontario in 1974 along the northern (191 µg/kg) and southwestern (172 µug/kg) shore and were associated with the high urban-industrial activity in the megalopolis of Hamilton-Burlington-Oakville-Missisauga -Toronto. However, the highest loadings occurred along Lake St. Clair where two large rivers, the Thames and Sydenham, discharge a much larger volume of suspended solids. The highest individual concentrations of HEOD (dieldrin) were found on suspended solids in two streams entering along the southwestern shoreline of Lake Ontario. However, the highest mean residues on solids for all streams was in waters entering Lake Erie (3 µg/kg) and the highest loadings were into Lake St. Clair. Endosulfan, chlordane, and heptachlor epoxide were detected in some streams entering all five lakes. No aldrin, endrin, mirex, heptachlor, or organophosphorus insecticides were detected.

DATA:

Primary Source.

116. FRAPE, S.K.
1979: Interstitial Waters and Bottom Sediment Geochemistry as Indicators of Ground Water Seepage; Unpublished Ph.D. Thesis, Department of Geological Sciences, Queen's University, Kingston, 323p.

ABSTRACT:

Field studies were carried out at three locations (1) Perch Lake near Chalk River, Ontario; (2) the Cataraqui River near Kingston, Ontario; and (3) Indian Lake, slightly north of Kingston, Ontario; to investigate ground water quality and deduce patterns of seepage in the nearshore areas of lakes and rivers.

Coring equipment was designed and built for the project and forty-two cores of lake and river bottom sediments, that ranged from 50 to 360 cm in length, were collected. Using specially constructed equipment, interstitial waters were extracted from sections of each core. As well, piezometers were installed in nearshore areas, to assess the quality of the ground waters adjacent to the lake or river. Additional quantitative measurements of seepage flux were taken at some sites using seepage meters.

Ground waters from piezometers and interstitial waters from sediment cores were analyzed for Ca, Mg, Na, K, Fe, Mn, $HCO_3$, Cl, $PO_4$, $SiO_2$ and in some cases Sr and $SO_4$. In addition, water samples from the Perch Lake site were analyzed for tritium and total inorganic carbon. The pH and $E_H$ were determined by direct insertion of the electrodes into sediments and by measurement in the waters. The water content of sediment samples, as well as the loss-on-ignition at 450°C was determined. After disaggregation, selected sediment samples were analyzed for organic and inorganic carbon content, and Si, Al, Na, K, Ca, Ti, P, Cr and S. All sediment samples were analyzed for acid extractable Fe, Mn, Zn, Cu, Pb, Ni, Co, and Cd.

Interpretation of the results of analyses of waters and sediments indicates that the theoretical seepage models presented by other researchers are generally valid. The maximum rate of seepage is in the nearshore area of lakes where shallow ground waters are discharged. Progressively deeper ground waters enter the water body at greater distances from shore. Geochemical interactions between sediments and ground waters seeping into lakes and rivers appear to cause enrichment of metals and other constituents at depths of up to 250 cm in some sediment sections.

DATA:

Primary Source.

117. FRAPE, S.K. and PATTERSON, R.J.
1981: Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario; Limnology and Oceanography, Vol. 26, No. 3, p. 500-517.

ABSTRACT:

A coring and squeezing technique was used to study seepage processes in Perch Lake. This lake was selected because a portion of the shallow aquifer in its basin contains tritium, which is an excellent tracer. Tritium analyses of interstitial water samples and well waters from piezometers adjacent to the lake indicate a pattern of groundwater discharge, or seepage, consistent with the predictions of mathematical simulations. Shallow groundwaters in the aquifer discharge almost vertically into the lake near the shore; water deeper in the aquifer enters the lake farther from shore. As a result of this groundwater discharge, metals such as iron and manganese are being deposited in the sediments.

Interstitial waters in Perch lake, especially nearshore, are groundwaters or groundwaters mixed with lake waters. The chemistry of interstitial waters in lake sediments may thus be determined by the quality of local groundwaters as well as by sediment-water reactions and vertical diffusional mixing. Data from nests of piezometers near the lake and from cores or multilevel piezometers in the lake bottom, information about bottom sediments, and measurements of seepage flux will be needed to estimate the contributions to lakes of dissolved components from groundwater discharge.

DATA:

Primary Source.

118. FURUTANI, A. and RUDD, J.W.M.
1980: Measurement of Mercury Methylation in Lake Water and Sediment Samples; Applied and Environmental Microbiology, Vol. 40, No. 4, p. 770-776.

ABSTRACT:

Biological mercury methylation was assayed by a new radiochemical technique in the water column and sediments of a mercury-contaminated lake. In 24 weeks during 1979, there were three episodes of methylating activity in surface floc and in water, each lasting 3 to 5 weeks. Periods of methylation in the water column coincided with surface sediment methylation and appeared to be related to overall microbial activity. Mercury was actively methylated in the presence of bound sulfide.

DATA:

Primary Source.

119. GARDNER, J.S.
1977: Some Geomorphic Effects of a Catastrophic Flood on the Grand River, Ontario; Canadian Journal of Earth Sciences, Vol. 14, No. 10, p. 2294-2300.

ABSTRACT:

A flood of unprecedented magnitude was recorded on the Grand River in southwestern Ontario on May 16-17, 1974. Peak discharge recorded at Galt has a return period of about 1 in 500 or a probability of 0.20 in any given year. Rare, high magnitude floods are of interest to the geomorphologist for the work they do on the terrain. Channel, floodplain, and valley side features produced by the 1974 flood were mapped and described on a reach of the Grand in its tributary, the Conestoga river. Erosional and depositional effects were minor except in the vicinity of man-made obstructions such as bridge piers where scour was evident. The minor geomorphic impact of the 1974 flood suggests that the Grand River valley is geomorphologically well-adjusted to handling large discharges. The findings coincide with observed effects of other high magnitude floods described in the literature.

DATA:

Primary Source.

120. GARRETT, M.R.
1981: Harbour Sedimentation; In: Erosion and Sedimentaion in Ontario, a Time for Action, Some Papers from the Winter, Summer and Fall Meetings of the Ontario Chapter, Soil Conservation Society of America, Erosion and Sedimentation, a Fresh Look at the Problem in Ontario, February 11, 1977, Canada Centre for Inland Waters, Burlington, p. 18-21.

ABSTRACT:

Harbours are valuable not only for commercial shipping but also for small craft harbours. Fishing, recreational boating, and sale of boats are all related to the value of harbours. Siltation to the extent of making harbours unsuitable for boating should be costly. Sediment which is derived from fluvial and biological sources may adversely affect recreational activities which occur in and around harbours. Upstream flooding is a by-product of sedimentation in harbours which have a river mouth component. Sediment can originate from several sources including fluvial, littoral or biological. The main source of sedimentation to the major natural harbours in this region is fluvial and in the Toronto region rivers are the major contributors. Factors affecting the quantity of sedimentation include physical characteristics of the watershed, meteorological conditions, and urbanization. Other sources of waterfront sedimentation in Toronto are sewers and littoral material eroded, accreted and transported in a coastal environment. Yet another source of

sedimentation is biological or organic sedimentation. Solutions to the problems of erosion and sedimentation are discussed. In the rivers, upstream erosion control, storm water management and reduced construction loadings could be implemented. In the sewers a regular maintenance programme could be implemented to clean out catch basins and along shorelines, littoral erosion control and strategically located protective works could be initiated. However, dredging would still be required. Because of polluted materials often found in sediments, disposal of dredgate is a problem and special disposal sites are made necessary. This has a drastic impact on the cost of maintaining harbours and waterways.

DATA:

Primary Source.

121. GAWRON, E.
1973: The Effect of Collecting Time and Grain Size on the Sampling of Stream Sediments for Geochemical Mapping in the St. Catharines Area, Ontario; Brock University, Department of Geological Sciences, Research Report Series No. 6, Studies in Landscape Geochemistry No.3, 33 p.

SUMMARY:

This report deals with the problem of collecting a representative sample of stream sediment material from a particular field site. The author examines five variable of the sampling problem: 1) sample inhomogeneity, 2) site inhomogeneity, 3) grain size of whole sample as collected 4) grain size of the -80 mesh sub sample and 5) time of year samples were collected.

DATA:

Primary Source.

122. GLOOSCHENKO, W.A.
1978: Sedimentary Geochemistry of a Lake Ontario Urban Marsh; Proceedings of the Second Workshop on Great Lakes Coastal Erosion and Sedimentation, 27 October, Burlington, p.63-64.

ABSTRACT:

The paper reviews a sedimentary geochemistry research program initiated on Rattray Marsh on the Lake Ontario shoreline at Mississauga, Ontario. The main areas of research are examined, that is, the source of sediments entering the marsh and subsequent dispersal, sedimentation rates and the influence of human activity, factors controlling the chemistry of sediments, and the measurement of potentially toxic chemical substances in the marsh sediments such as heavy metals, pesticides and PCBs.

DATA:

Primary Source.

123. GLOOSCHENKO, W.A., CAPOCIANCO, J., COBURN, J. and GLOOSCHENKO, V.
1981: Geochemical Distribution of Trace Metals and Organochlorine Contaminants of a Lake Ontario Shoreline Marsh; Water, Air and Soil Pollution, Vol. 15, No. 2, p. 197-213.

ABSTRACT:

As part of a water quality study on Rattray Marsh, a suburban marsh located on the Lake Ontario shoreline at Mississauga, Ontario, a sedimentary geochemistry study was initiated. In general, Cu, Zn, Pb and Hg were higher in concentration than in local soils, but lower than Lake Ontario recent sediments. Over the past century, an approximate two-fold increase in the sedimentary levels of Cu, Zn, Co, Cr and Ni occurred, while Cd increased nearly 4x, and Pb, 8x. No correlation was found between metals and organic carbon, and the metals appear to be associated with silts and clays as evidenced by (1) factor analysis of geochemical data, (2) higher concentrations in areas of the marsh subjected to high sediment deposition, and (3) analysis of a suspended sediment sample from Sheridan Creek, the main tributary basin of the marsh. Organochlorine contaminants include p, $p^1$-DDE, p, $p^1$-DDT, x-chlordane, PCB, mirex and HCB.

DATA:

Primary Source.

124. GRAHAM, A. and KNIGHT, G.
1983: Sediment Basin Demonstration Project; Technical Report No. R-13, Thames River Implementation Committee and Stratford/Avon River Environmental Management Project, 22p.

ABSTRACT:

An in-channel sediment basin was constructed on the Avon Municipal Drain, Lot 16, Con. II of North Easthope Township. This uppermost section of the Avon falls into the SAREMP's Demonstration Sub-Watershed where a variety of remedial measures have been put into place over the three-year study period. The purpose of the sediment basin was to determine the costs and benefits of sediment basin construction in municipal drainage works with regard to reduced drain cleanouts and improved water quality.

The basin constructed in November, 1980 at an approximate cost of $4000. Over the first two years of its operation, the basin has trapped 1030 $yd^3$ of sediment. The demonstration project has been well received both locally and by visiting professional personnel. Continued monitoring of the basin's effectiveness will give a better indication of cleanout frequency and of the long-term effect on water quality.

DATA:

Primary Data; also refer to Ontario Ministry of the Environment data.

125. GREAT LAKES INSTITUTE
1983: A Case Study of Selected Toxic Contaminants In the Essex Region; Progress Report No. 1, D.S.S. Contract UP-G-175, 316p.

ABSTRACT:

This is the first report submitted by the Great Lakes Institute of the University of Windsor under its contract (UP-G-175) with the Department of Supply and Services for Environment Canada.

The research here reported concerns a case study of four such toxic substances, the isomers of polychlorinated biphenyls (PCB), octachlorostyrene (OCS), lead (Pb) and cadmium (Cd). The purpose is to identify the sources where possible and to determine the impact on the ecosystem and the economic and social structure of the Essex region.

DATA:

Primary Source; Refer to chapter I (b) Analysis of Metals by P. McQuarrie and J. Choi, p. 13-26 and Appendix 1, p. 232-243.

126. GREER, D.
1981: Erosion and Sedimentation in River Valleys; In: Erosion and Sedimentation in Ontario, a Time for Action, Some Papers from the Winter, Summer and Fall Meetings of the Ontario Chapter, Soil Conservation Society of America, Erosion and Sedimentation, Urban Erosion and Sedimentation, Planning for Prevention, June 17, 1977, Humber College, Toronto, p. 35-40.

ABSTRACT:

The two basic means of controlling erosion and sedimentation which are corrective measures or preventative measures, are discussed in this paper. The Credit Valley Conservation Authority has completed erosion control works on authority owned lands, however, urban development has increased erosion on private lands necessitating the authority to adopt policies with respect to erosion control on private lands. The mandate of the authority limits its area of responsibility to erosion caused by natural processes as a direct result of protecting private property, the benefits derived by the authority are improvements in the hydrological flow of the watercourse and the reduction of silitation. The main erosion problems are located on the Credit River, Cooksville Creek and Sheridan Creek. Hazards to residential buildings occur on 8% of the watercourses and for this reason the authority has contracted a hazard area study for its watershed. The results of the study will provide information on existing erosion, its severity, a priority system for remedial works and necessary action to avoid erosion problems in future developments. The erosion problem of St. Peter's Anglican church on the Credit River is discussed and the construction of a gabion

retaining wall as the solution is explained. The steps necessary to prevent erosion and sedimentation problems via the subdivision review process are discussed and the Creditview subdivision the Credit River is reviewed as a case study. Most of the problems of erosion and sedimentation are the result of past development problems and future problems can be avoided at minimal cost through adequate planning controls.

DATA:

Secondary Source.

127. GRIFFITHS, M.
1978: Effects of Industrial Effluents on Water Quality, Sediments and Benthos of the St. Lawrence River at Maitland, Ontario; Report, Ontario Ministry of the Environment, Water Resources Branch, Planning and Co-ordination Section, Great Lakes Surveys Unit, 48p.

ABSTRACT:

In 1975, the Water Resources Branch of the Ministry of Environment initiated a study of the St. Lawrence River at Maitland, Ontario, aimed at:

1. Determining the extent of water and sediment quality impairment associated with effluent discharges from Genstar Chemical Limited ad DuPont of Canada Limited.

2. Assessing the effects of these discharges on the St. Lawrence River benthic community, sediments and water quality.

3. Identifying the need for abatement measures.

DATA:

Primary Source.

128. GUPTA, S.K.
1974: A Distributed Digital Model for Estimation of Flows and Sediment Load from Large Ungauged Watersheds; Unpublished Ph.D. Thesis, Department of Civil Engineering, University of Waterloo, Waterloo, 354 p.

ABSTRACT:

Techniques, usually adopted for data transfer on sediment yield from ungauged watersheds are reviewed.

A distributed, parametric, digital model for the estimation of daily flows and sediment load from ungauged watersheds is developed. The need for a distributed model in the case of

sediment yield estimation is documented. The model can be easily applied to an area using the data and auxiliary information which are usually available for most regions in Canada and other countries.

Methodology of the derivation of the river basin data file system, which forms the base for the organization of the model, is presented along with the related computer programmes. The model uses a modified Muskingam routing technique along with hydromorphological relationships developed for the purpose of the study in the flow phase of the model. Various semi-emipirical and physical relationships along with Goncharov's theory of sediment transport in natural channels are used in the sediment phase of the model.

The flow phase has four parameters, all related to the hydraulic characteristics of the soils. The sediment phase has five parameters related to the erosion characteristics of the soils.

Recommendations for extending the soil surveys to investigate the soil characteristics needed for developing distributed hydrologic and sediment models are made. Other suggestions, related to both, the data collection and development of physical relationships have been made.

DATA:

Secondary Source; refer to Water Survey of Canada data.

129. GUPTA, S.K. and SOLOMON, S.I.
1977: Distributed Numerical Model for Estimating Runoff and Sediment Discharge of Ungaged Rivers:1. The Information System; Water Resources Research, Vol. 13, No. 3, p.613-618.

ABSTRACT:

The need for a distributed numerical model for information transfer on runoff and sediment discharge from a gaged river section to any section of the river or its tributaries is discussed. The methodology of developing the information system, which forms the basic structure for the development of such a model, is briefly described. The advantages of the proposed information system are presented, and suggestions to further improve it are made.

DATA:

Secondary Source; refer to Water Survey of Canada data.

130. GUPTA, S.K. and SOLOMON, S.I.
1977: Distributed Numerical Model for Estimating Runoff and Sediment Discharge of Ungaged Rivers:3. Comparison with Other Simple Techniques; Water Resources Research, Vol. 13, No. 3, p. 631-636.

ABSTRACT:

In two earlier papers published by the authors (Gupta and Solomon, 1977; Solomon and Gupta, 1977) the development of an information system and of a distributed hydrologic model based on it was described. The model can be used to estimate flow and sediment at ungaged river sections. In this paper the authors compare, in detail, the results obtained in estimating flows and sediment discharges by means of the model at two stations with estimates of the same hydrologic characteristics obtained by means of other simpler techniques. The results of the comparison indicate improvement over the simpler techniques, the indication being that the application of the model is justified where a higher accuracy of flow and sediment data is required or where lack of basic measurement data makes it impossible to apply the simpler techniques.

DATA:

Secondary Source; refer to Water Survey of Canada data.

131. HAMDY, Y.S., KINKEAD, J.D. and GRIFFITHS, M.
1977: Water Quality Assessment of the Thames River Mouth, Lake St. Clair 1975; Report, Ontario Ministry of the Environment, Water Resources Branch, Planning and Co-ordination Section, Great Lakes Surveys Unit, 30 p.

SUMMARY:

The localized impact of the Thames River on the water quality of Lake St. Clair results from its nutrient and solids load and bacterial contamination from upstream sources. The Thames River is a minor contributor to the enrichment of Lake St. Clair since its nutrient load represents <1% relative to the input from the St. Clair River.

The influence of the Thames River was observed to be to the north-northeast of the mouth as a result of prevailing winds. This zone of influence was found to extend as far as 8-10 km into the lake and was characterized by nutrient levels at least twice as high as those in mid-lake. Chlorophyll *a* levels close to the mouth were indicative of eutrophic conditions.

Bacterial levels exceeded Ministry of the Environment (MOE) recreational use criteria (19) in a zone extending 3 km into the lake and 1 km along the shore, making the sandy beaches within this zone questionable for swimming. Observed bacterial levels however, did not appear to interfere with the water supply serving the Town of Tilbury.

Sediments in the study area were relatively uncontaminated, except for elevated levels of zinc, organic carbon and nitrogen found at the river mouth. The zinc and organic carbon levels exceeded MOE guidelines (19) for open-water disposal of dredged materials. The zoobenthic community in the area was characterized by the presence of pollution intolerant organisms suggesting that the Thames River has little deleterious effect on the benthic community (Appendix B).

A program is currently being developed by the Thames River Implementation Committee to implement the recommendations outlined in the Thames River Basin Water Management Study (1). The implementation of these recommendations will involve a long-term program that includes both direct remedial action and supportive educational efforts to achieve nutrient loading reductions and soil erosion controls throughout the basin. The expected benefits of such a program includes the protection and enhancement of water quality in Lake St. Clair in the vicinity of Thames River Mouth.

DATA:

Primary Source.

132. HAMDY, Y., KINKEAD, J.D. and GRIFFITHS, M.
1978: St. Mary's River Water Quality Investigations, 1973-74; Report, Ontario Ministry of the Environment, Water Resources Branch, Great Lakes Survey Unit, 53p.

ABSTRACT:

This report discusses the quality of water, sediment and biota in the river and the potential toxicity of industrial discharges. Results show that water quality throughout most parts of the St. Mary's River was found to be generally satisfactory and basically resembled that of Lake Superior. Biota, sediments and water quality along the U.S. shore of the river and in Lake Nicolet indicated that conditions were good and that this area could sustain a variety of water uses.

Water quality impairment was restricted to a narrow band along the Canadian shore. Natural and man-made constraints favour much lower river flows along the Canadian shore than on the opposite side which coupled with the lateral discharge from the Edison Sault Hydro-electric Power Canal tend to continue the contaminants to the Ontario shoreline.

The major industrial sources contributing to water quality impairment are Algoma Steel Corporation Ltd. and Abitibi Paper Company. While partial recovery from the effects of these industrial inputs takes place through the Lake George Channel, discharges from the Sault Ste. Marie sewage treatment plant (STP) delay the restoration of satisfactory water quality.

DATA:

Primary Source.

133. HAMDY, Y. and POST, L.
1985: Distribution of Mercury, Trace Organics and Other Heavy Metals in Detroit River Sediments; Journal of Great Lakes Research, Vol. 11, No. 3, p. 353-365.

ABSTRACT:

In 1980 the Ontario Ministry of the Environment carried out a surficial bottom sediment survey of the Detroit River. The survey was designed to update changes in sediment mercury levels from a 1970 study, and to determine the spatial distribution of trace organics and other heavy metals as a baseline for future investigations. The contamination of sediments along the Ontario shoreline of the river was localized near know inputs such as Little River, the West Windsor sewage treatment plant, Turkey Creek, and Riviere aux Canards. Almost the entire U.S. shoreline sediments exhibited elevated levels (above provincial dredging guidelines) of contaminants such as heavy metals and PCBs. Levels of one order of magnitude higher than those on the Canadian shore were prevalent along the U.S. shore. Mercury levels exhibited a substantial decline during the period 1970-1980. Increases in chromium, copper, lead and zinc in the vicinity of the mouth of the Rouge River along the U.S. shoreline during the same period suggest both recent and continuing inputs from industrial and municipal sources.

DATA:

Primary Source.

134. HARPER, N.S.
1982: Data Report: Pollen Analyses of Sediment from Turkey Lakes Cores, Algoma Calibrated Watershed, Ontario; Turkey Lakes Watershed Unpublished Report No. TLW-82-07, 46 p.

SUMMARY:

Report contains absolute pollen frequencies of Acer, Ambrosia, Pinus and Quercus in a lake sediment cores collected from all the lakes in the Turkey Lakes Watershed. Methodology is outlined.

DATA:

Primary Source.

135. HESSLEIN, R.H., BROECKER, W.S. and SCHINDLER, D.W.
1980: Fates of Metal Radiotracers Added to a Whole Lake: Sediment Water Interactions; Canadian Journal of Fisheries and Aquatic Sciences. Vol. 37, No. 3, p. 378-386.

ABSTRACT:

A whole-lake radiotracer experiment with the isotopes Se-75, Hg-203, Cs-134, Fe-59, Co-60 was carried out in Lake 224 of the

Experimental Lakes Area, northwestern Ontario. The results of the analyses of isotopes in the water column show an exponential decrease in concentration with time. The rate of loss from the water column does not show dependence on the affinity of the isotope for suspended particulate material. This affinity ranged from 98% for Fe-59 to <1% for Cs-134 over the first 65d. The major sink for isotopes lost from the water column is the sediments. Ratios of isotopes in the sediments show that those isotopes associated with suspended particulates more easily reach deep sediments than those in dissolved form which are restricted by the thermocline to adsorption to epilimnion sediments.

DATA:

Primary Source.

136. HILL, A.R.
1979: Denitrification in the Nitrogen Budget of a River Ecosystem; Nature, Vol. 281, No. 5729, p. 291-292.

ABSTRACT:

Recent studies indicate that bacterial denitrification in anaerobic sediments may play a major part in removing nitrogen from water during river transport. As this reaction reduces nitrate-N primarily to gaseous nitrogen, it represents a potentially significant pathway for the permanent removal of nitrogen from aquatic environments. However, no detailed assessments have been made of the quantitative importance of denitrification in relation to river nitrogen budgets. I have investigated this problem by studying the role of denitrification in relation to the nitrogen budget of Duffin Creek near Toronto, Ontario, and report here that the removal of nitrate-N by denitrification in the downstream reaches of the river represents 5-6% of the annual export of total nitrogen from this river basin.

DATA:

Primary Source.

137. HILL, A.R.
1981: Nitrate-Nitrogen Flux and Utilization in a Stream Ecosystem During Low Summer Flows; Canadian Geographer, Vol. 25, No. 3, p. 225-239.

ABSTRACT:

Analysis of nitrate transport in the downstream reaches of Duffin Creek, Ontario, revealed an average daily loss of 45 kg nitrate-N during low summer flows. The nitrate loss represents 50 percent of the average daily input of total nitrogen and 75 percent of the nitrate input received by these channel reaches. Nitrate uptake

by benthic algae appears to account for a small portion of the $NO_3$ removal. Laboratory experiments suggest that most of the nitrate disappearance from the river reaches is caused by bacterial denitrificiation and nitrate reduction in stream sediments.

DATA:

Primary Source.

138. HILL, A.R. 1981: Stream Phosphorus Exports from Watersheds with Contrasting Land Uses in Southern Ontario; Water Resources Bulletin, Vol. 17, No. 4, p. 627-634.

ABSTRACT:

The export of dissolved molybdate reactive phosphorus (DRMP) from 22 watersheds in the Duffin Creek drainage basin near Toronto Ontario was measured over a 25-month period. The annual average loss varied from 0.027 to 2.11 kg P/ha. Phosphorus levels in a number of watersheds were strongly influenced by effluent from a sewage treatment plant which contributed about 68 percent of the annual DMRP input to Duffin Creek. An analysis of 12 watersheds which did not contain major point pollution sources revealed that DMRP concentration and losses had a significant positive correlation with crop area and a strong negative association with forest, abandoned farm land, and area of sand + sandy loam soils. The causal relationships underlying these simple correlations are difficult to evaluate because of considerable multicollinearity between land use, soil, and topographic variables. Analysis of a mass balance for the downstream reaches of Duffin Creek indicated that there was considerable retention of phosphorus in the river channel particularly during summer low flows.

DATA:

Primary Source.

139. HILL, A.R. 1982: Phosphorus and Major Cation Mass Balances for Two Rivers During Low Summer Flows; Freshwater Biology, Vol. 12, No. 3, p. 293-304.

ABSTRACT:

Soluble reactive phosphorus (SRP) mass balances showed that phosphorus retention occurred during low summer flows in reaches of Duffin Creek and the Nottawasaga River, two phosphorus-rich streams in southern Ontario. The average daily removal in Duffin Creek was 6.1 + 1.6 kg SRP which represents the retention of about 92% of the phosphorus input. Approximately 5.3 + 3.5 kg SRP

(about 44% of the daily input) was removed from stream water in the Nottawasaga River. Laboratory experiments indicate that sorption by stream-bed sediments is an important mechanism for phosphorus retention in both rivers. Uptake by benthic algae may also act as a temporary phosphorus sink in Duffin Creek. Major cation inputs and outputs are generally in balance, implying that these elements act in a relatively conservative manner in both rivers.

DATA:

Primary Source.

140. HILL, A.R.
1983: Denitrification: Its Importance in a River Draining an Intensively Cropped Watershed; Agriculture, Ecosystems and Environment, Vol. 10, No. 1, p. 47-62.

ABSTRACT:

Nitrogen transport was studied during summer low flows in a 20 km reach of the Nottawasaga River which drains an intensively cropped sand plain which has an underlying shallow water-table aquifer. Nitrogen inputs to the river were measured on 30 days in May to October of 1977-81. These data indicated that about 38% of the daily nitrate input entered the river through ground water. The magnitude of this input is a consequence of widespread contamination of the shallow aquifer by nitrogen fertilizer. Ground water entering the river from springs and seeps near fertilized fields frequently contained more than 10 mg $l^{-1}$ of $NO_3$-N. Mass balance studies of nitrogen transport in the river revealed an average daily nitrate loss of 46±23 kg N. This rate of nitrate removal represented about 40% of the ground water input to the river from the sand plain. Analysis of a mass balance for total Kjeldahl revealed an essentially balanced budget, whereas chloride showed a small daily gain of about 5%. Laboratory experiments involving the incubation of stream sediment cores and the use of the acetylene block technique suggested that the bulk of the nitrate loss during river transport was caused by denitrification in bottom sediments.

DATA:

Primary Source.

141. HILL, A.R.
1986: Nitrate Transformations in Rural Streams; Canadian Water Resources Journal, Vol. 11, No. 1, p. 126-134.

ABSTRACT:

This review considers the extent and nature of nitrate transformations in rural streams. Mass balance studies have

revealed considerable evidence for nitrate depletion during stream transport in agricultural landscapes. A variety of processes may be responsible for these nitrate losses. Several studies have indicated that uptake by aquatic macrophytes can be important in nitrate depletion. However, denitrification which occurs in anaerobic stream sediments has been implicated as the major cause of nitrate losses in many rural streams. The importance of denitrification in streams has been confirmed by the use of labelled $NO_3$-N and acetylene blockage experiments. A wide range of stream sediments which include acidic sands, organic muds and calcareous silts exhibit a denitrification potential. Denitrification has also been identified in algal mats and slime enmeshed microbial communities on rock gravel surfaces in streams. Denitrification is affected by a number of environmental factors which include water temperature and stream $NO_3$-N concentration. Several recent studies have shown that denitrification rates are influenced by chemical and physical properties of stream sediments. In particular, denitrification may exhibit a significant positive correlation with the water soluble carbon content of sediments.

DATA:

Secondary Source; refer to Hill (1981, 1983), Robinson et al. (1979) and Sain et al. (1977).

142. HILL, A.R. and SANMUGADAS, K.
1985: Denitrification Rates in Relation to Stream Sediment Characteristics; Water Research, Vol. 19, No. 12, p.1579-1586.

ABSTRACT:

Potential rates of nitrate removal were studied in sediments from three Ontario rivers that differed in texture, organic carbon contents and other characteristics. Intact 0-5 cm depth sediment cores from 22 sites on each river were overlain with aerated 5 mg $l^{-1}$ $NO_3$-N solution and incubated in the laboratory at 21°C for 48 hours. Rates of nitrate-N loss from the overlying solutions varied from 37 to 412 mg $m^{-2}day^{-1}$ for a 24 hour incubation period. The acetylene blockage technique was used with nitrate amended sediments to evaluate the relative importance of denitrification and nitrate reduction to ammonium. Denitrification accounted for 80-100% of the nitrate loss in the majority of sediment samples tested. Rates of nitrate loss for the 24 hour period exhibited a highly significant positive correlation (r=0.82-0.89) with the water-soluble carbon content of the sediments in each river. Significant relationships were also observed between nitrate loss and organic carbon, total nitrogen and sediment ammonium. A decline in nitrate loss via denitrification and increased nitrate reduction to ammonium was correlated with the organic carbon and water-soluble carbon content of the stream sediments.

DATA:

Primary Source.

143. HINDLEY, B.A., HUBBARD, R.P. and MAUDE, S.H.
1985: Upper Humber River Water Quality Study. Toronto Area Watershed Management Strategy Steering Committee, Technical Report no. 8, 101 p.

SUMMARY:

As a result of detailed pollution studies on the lower Humber River from 1982-83 as part of the Toronto Area Watershed Management Strategy Study (TAWMS) it became apparent that violations of the Ministry of the Environment's (MOE) Provincial Water Quality Objectives (PWQO) in the Humber River occurred north of the Metropolitan Toronto boundary. Therefore in order to address the TAWMS objective of restoring water quality to PWQO, the incorporation of corrective measures in the Humber River north of Steeles Avenue was deemed necessary as part of the overall strategy. Specifically, exceedances of fecal coliform bacteria (FC), total phosphorus (TP), total suspended solids (TSS), lead (Pb), cadmium (Cd) and copper (cu) were of concern.

Accordingly, in 1984 the MTRCA received a grant from the MOE to undertake a water quality study in the Upper Humber watershed. The general objective was to identify in more detail the sources of selected chemical and microbiological pollutants in the Upper Humber.

The study consisted of:

- a mapping exercise to identify areas of potentially high overland sediment delivery in rural areas of the watershed using an adaptation of the Universal Soil Loss Equation.

- a series of dry and wet weather surface water sampling surveys (Synoptic Survey, Dry Events 1-3, Wet Event) and a bed sediment sampling survey, both aimed at evaluating the contaminant contributions of Upper Humber subbasins.

- a field inventory to identify land use problems (eg. livestock access), point source inflows and stream bank erosion sites impacting on watercourses in the Upper Humber watershed.

DATA:

Primary Source.

144. HOLDEN, E.
1985: Water Erosion and Sedimentation and Its Control in Urban Area; Unpublished B.A. Thesis, Department of Geography, University of Waterloo, Waterloo, 73 p.

ABSTRACT:

Not available at time of publication.

145. HORE, R.C. and OSTRY, R.C.
1978: Saugeen River, Ontario. Summary Pilot Watershed Report; Task Group C: PLUARG, International Joint Commission, Windsor, 56 p.

ABSTRACT:

Water-quality data collected under the PLUARG program during the period 1975-1976 indicate that while variations across the Saugeen River basin are not dramatic, they broadly reflect increased agricultural activity in the lower reaches of the basin. Streams draining the headwater reaches which are mainly in swamp, non-productive woodland and permanent pasture, are of relatively better quality than the waters at the mouth of the basin. The pollutant impact of the Saugeen River basin on the water quality of the Great Lakes is minimal.

The major sources of pollution from land uses studied in the Saugeen River basin have been tentatively identified as follows:

| | |
|---|---|
| Urban | metals |
| Point Sources | metals, organic chemicals, phosphorus, nitrogen |
| Transportation | lead, chloride |
| Private-waste disposal | phosphorus |
| Agriculture | sediment, phosphorus, nitrogen |

The Saugeen River basin with an urban population density of approximately 8 people per hectare lacks the urban population concentration found in other parts of the Great lakes basin. The urban impact on the pollution load at the mouth of the river is approximately the same as the percentage of land in urban land use (i.e. one percent). Phosphorus removal does not exist at sewage treatment plants in the basin and this results in a high per capita yield (2.64 g/day/capita) of phosphorus discharged to the receiving waters of the Saugeen River. Significant inputs of total phosphorus (7% of the load at the mouth) are estimated to be from point-source discharges.

Pollutant ranking suggest that urban runoff relative to drainage from agriculture and wooded land yields greater unit-area loads of total phosphorus, sediment, chlorides and metals. However, the impact from urban runoff in the Saugeen River basin is not significant because of the small area of urban land use. The ranking also suggests that agricultural runoff compared to urban and wooded areas is the major contributor in the basin for nitrogen and filtered reactive phosphate.

Highway deicing agents were identified as being the major contributor of the chloride at the mouth of the Saugeen River. The chloride load due to deicing agents is estimated to be in the order to 40% of the total load at the mouth.

In addition to significant inputs of phosphorus from agricultural activities and private-waste disposal systems increased levels of nitrogen creating localized ground-water problems may also occur as a result of these land uses and practices in the basin. Private-waste disposal systems which are properly constructed are of minor concern.

Minimal impacts on stream-water quality have been monitored from waste disposal practices such as sanitary landfills, processed organic waste and spray irrigation. This is in part due to the limited areal extent of these land uses and practices in the watershed. Increased land usage of these practices could create an ultimate health hazard if proper design and management of the sites are not observed.

Monitoring data suggest that the bulk of the river loads (up to 95%) are transported during the months of February, March, April and May. Toxic materials such as heavy metals, pesticides and organic chemicals have a strong affinity for the clay-size sediment fraction which is transported as suspended material in the water. PLUARG monitoring data indicate that the percentage of the total load due to the particulate fraction varies from 10 to 50% for copper, 50 to 70% for lead and 20 to 70% for zinc. Management strategies for these toxic elements should consider sediment control.

Monitoring data demonstrate that in-stream deliveries of sediment and sediment associated pollutants can be extremely variable and less than 100% in some river reaches. Gross estimates of in-stream transport functions, to determine the proportion of the pollutant input that is transported downstream, were prepared for subwatersheds in the Grand River basin. These functions ranged from 32-100% for in-stream transport of pollutants within selected river reaches.

Data from a small river reach near the headwaters of the adjoining Grand River watershed suggest that up to 50% of the soluble phosphorus can be retained on a daily basis by the aquatic weeds due to biological uptake during growth periods. In terms of the Grand River basin, aquatic weed growth may have a significant impact on the phosphorus export from the watershed during the active growth periods of the biomass.

Extrapolation of the pilot watershed data to unmonitored areas in the Great Lakes basin is possible provided the characteristics of the unmonitored areas are similar to those in the pilot watershed. In terms of extrapolation to other parts of the Great Lakes basin, the critical diffuse sources of pollutant contribution have been identified as being urban and agricultural land uses and practices. Based on the pilot watershed information, the most cost-effective remedial measures for the Great Lakes basin will be those that control runoff from agriculture and urban areas.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

146. HORE, R.C. and OSTRY, R.C.
1978: Grand River, Ontario, Summary Pilot Watershed Report; Task Group C, PLUARG, International Joint Commission, Windsor, 63 p.

ABSTRACT:

The major sources of pollution in the predominantly agricultural Grand River Basin have been identified from the Task C studies.

| | |
|---|---|
| Urban | metals, organic chemicals, bacteria, phosphorus |
| Point-sources | metals, organic chemicals, phosphorus, nitrogen |
| Transportation | lead, chloride |
| Private-water Disposal | phosphorus |
| Agriculture | sediment, phosphorus, nitrogen |

Water-quality monitoring data collected under the PLUARG program during the period 1975-1976 in the Grand River watershed suggest that progressive pollution of the Grand River is occurring from the headwaters to its mouth at Lake Erie. The headwater areas are relatively clean. Pollutant loads increase consistently downstream in the central and lower regions of the watershed, reflecting the impacts of both the intensive agricultural activity and urban sprawl on the water quality of the receiving waters in these portions of the watershed.

Extrapolation of the pilot watershed data to unmonitored areas in the Great Lakes Basin is possible, provided the characteristics of the unmonitored areas are similar to those in the pilot watershed. In terms of extrapolation to other parts of the Great Lakes Basin, the critical diffuse sources of pollutant contribution have been identified as being agriculture and urban land uses and practices. Based on the Grand River watershed information, the most cost-effective remedial measures to moderate non-point sources of pollution in the Great Lakes Basin will be those that control pollutant runoff from agriculture and urban areas.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

147. HUHN, F.J.
1974: Lake Sediment Records of Industrialization in the Sudbury Area of Ontario; Unpublished M.Sc. Thesis, Department of Geography, University of Toronto, Toronto, 84 p.

ABSTRACT:

Industrialization has drastically modified the original Great Lakes Saint Lawrence forest around Sudbury. A combination of logging, smelting and forest fires (agricultural is of little importance), all related to mining and smelting of the rich nickel-copper sulphide ores of the Sudbury intrusive, have destroyed vegetation and prevented normal succession. This recent forest destruction was caused by sulphide fumes combined with heavy metal residues in the soil and erosion.

A record of this impact exists in the sediments of local lakes. Changes in the yearly fallout from the atmosphere of pollen grains, smoke particles and heavy metals reflect the changes that occurred in the vegetation cover. These correspond with changes in the production of smoke and metallic effluents by the Sudbury smelters.

Sediments of two lakes were studied. Loon Lake has deep-water sediments containing countable seasonal laminations. These dated the inital vegetation change at about 1880-1885. Changes have continued to the present. The first sign of European man in the sediments is an increase in Ambrosia at about 1835-1840, but the date 1880-1885 corrresponds to the historic record of the beginning of the Sudbury mining and smelting industries. At this time tree pollen declined and there was an increase of smoke particles and heavy metal residues in both lakes examined.

The record is divided into four zones by three major events. These are the Ambrosia rise, signalling the arrival of European man south of the Sudbury area, the smoke particle rise at the beginning of the local mining and smelting industry and a sharp rise in pollen influx during the years 1930-1935 related to decreased effluent production. Weed pollen types increase at the time of the Ambrosia rise, but there is little change in tree species until the smoke particle rise. At this time there are large increases in weeds and declines in tree species, especially Pinus.

DATA:

Primary Source.

148. HUTCHINSON, T.C. and FITCHKO, J.
1974: Heavy Metal Concentrations and Distributions in River Mouth Sediments around the Great Lakes; Proceedings of the International Conference on Transport of Persistent Chemicals in Aquatic Ecosystems, Ottawa, May 1-3, 1974, p. I69-I77.

ABSTRACT:

Surface and core samples of sediments have been collected in 1972 and 1973 from the mouths of rivers flowing into the Great Lakes. These samples have been analyzed by atomic absorption spectrophotometry for the metals Hg, Pb, Zn, Cu, Ni, Co, Mn, Cr and Ag. One objective of this study is to make a general comparison of the relative degree of heavy metal accumulation in sediments between the Great Lakes. Striking differences in lotic inputs of heavy metals have been found between the individual Great Lakes. Core sample analyses indicate 'homogeneous' concentrations probably due to dredging, shipping activity and water currents. In additions, the relationship between the types of sediments and their metal content is assessed. This includes consideration of such factors as particle size and organic content.

DATA:

Secondary Source; refer to Fitchko (1974).

149. HYNES, H.B. and DANCE, K.W.
1977; Comparative Nutrient Budget of the Two Branches of Canagagigue Creek; Report, Task Group C, Project 19, Part B, PLUARG, International Joint Commission, Windsor, 42 p.

ABSTRACT:

The quantities of drifting solid organic matter (S.O.M.) in two size particle ranges were sampled weekly for thirteen months at four stations on the upper reaches of the Canagagigue Creek. Two stations were located on each of the east and west branches of the Creek.

The particle size ranges sampled were 1.3 - 3.0 cm and 253 micron - 1.0 cm. The material within these size ranges was divided into recognizable fractions: green, coniferous, deciduous algae, detritus and aquatic animals. Nutrient analyses were conducted on monthly bulked fraction samples. S.O.M. was analyzed for the percentage of organic matter, the percentage of total phosphorus in the organic matter.

Agricultural plant material was not found to contribute a significant amount of material to the stream.

The fraction which contributed the greatest quantities of S.O.M. and nutrients was that of detritus and algae in the particle size range 253 microns - 1 cm. This fraction contained organic detritus as well as quantities of inorganic material which had been churned up from the stream bed.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

150. IHNAT, M.
1978: Agricultural Sources, Transport and Storage of Metals: Copper, Zinc, Cadmium and Lead Levels in Waters of Selected Southern Ontario Agricultural Watersheds; Technical Report, Task Group C (Canadian Section), Project 9B, PLUARG, International Joint Commission, Ottawa, 156 p.

ABSTRACT:

The objective of Project 9 was to determine and assess the relationship between concentrations of selected heavy metals in stream waters, suspended sediments, bottom sediments and soils within selected agricultural watersheds draining into the lower Great Lakes, with the aim of elucidating sources, storage and transport mechanisms of these elements. In support of these goals, the main objective of the investigation was to obtain reliable analytical information regarding concentrations of Cu, Zn, Cd and Pb in waters and suspended sediments from the six watersheds: AG 1 (Big Creek), AG 3 (Upper Little Ausable River), AG 4 (Canagagiuge), AG 5 (Holiday Creek, tributary of Middle Thames River), AG 10 (North Creek, tributory of Twenty Mile Creek) and AG 13 (west branch of Hillman Creek).

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

151. IHNAT, M.
1982: Copper, Zinc, Cadmium and Lead in Waters of Selected Southern Ontario Agricultural Watersheds; International Journal of Environmental Analytical Chemistry, Vol. 11, No. 2, p. 189-210.

ABSTRACT:

Concentrations of Cu, Zn, Cd and Pb were determined in stream waters of six agricultural watersheds in Southern Ontario draining into the lower Great Lakes. Over all watersheds, samples collected during 1976 and the spring of 1977, had median concentrations + analytical standard error, of elements in dissolved form of 2.0 + 1.8 (range 0.5-18.5), 3.1 +2.7 (range 0.1-11.4), 0.07 + 0.06 (range 0-0.57) and 0.1+0.2 (range 0-13.1) µg/l for Cu Zn, Cd and Pb respectively. Respective median total concentrations were 3.9 + 2.6 (range 2.4-445), 17.2 + 4.9 (range 4.3-2500), 0.08 + 0.02 (range 0.03-13.4) and 3.7 + 10 (range 0.9-433) µg/l for Cu, Zn, Cd and Pb. Concentrations of elements in dissolved form were invariable with, whereas total concentrations were proportional to suspended sediment levels whose range was from 10 to 19,000 mg/l with a median of 20 mg/l. Mode of transport was found to depend on suspended sediment level. In waters with low suspended sediment levels, below ca 20 mg/l, the majority of Cu and Zn was transported in dissolved form, whereas the suspended sediment accounted for most of the transport

elements at a higher particulate loads. Agricultural activities were estimated not to result in any gross contribution of these trace metals to the waters of these drainage systems.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

152. INTERNATIONAL LAKE ERIE WATER POLLUTION BOARD and INTERNATIONAL LAKE ONTARIO, ST. LAWRENCE RIVER WATER POLLUTION BOARD
1969: Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River; Report to the International Joint Commission, 329 p.

ABSTRACT:

This report has been prepared in three volumes. In volume 1 the Boards have endeavoured to summarize the findings and to identify the critical problems of pollution, and pollution control measures which are of immediate concern to both countries as well as those long range problems which must be brought under continuing review and study. Volume 2 contains the scientific and engineering data and finding which have been used to determine the sources and levels of pollution in Lake Erie, as well as recommendations for the necessary remedial measures. Volume 3 contains similar information for Lake Ontario and the international section of the St. Lawrence River.

DATA:

Primary Source; also refer to Ontario Water Resources Commission data.

153. IRVINE, K.N.
1985: Analysis of Suspended Sediment in the Ausable River, Southern Ontario; Unpublished M. Sc. Thesis, Department of Geography, McMaster University, Hamilton, 171 p.

ABSTRACT:

The characteristics of suspended sediments in the Ausable River, Southern Ontario are examined through field observations, laboratory analysis and various modelling techniques. High frequency sampling from April 2 to September 30, 1984 provided detailed information on the variability of suspended sediment concentrations during event and inter-event periods. Hydraulic parameters were calculated for different flow regimes in order to evaluate the suspended concentration-fluid mechanics relationship. The variability in suspended sediment concentrations was linked to: a) hydro-meteorologic factors such as highflow events and changing hydraulic conditions; b) sediment availability which was controlled for example, by seasonal change and antecedent conditions; c) random fluctuations.

Suspended sediment records (1970-1983) were analyzed using simple and multiple regression, ARIMA and partial duration series techniques. The regression and ARIMA modles were used to: a) predict suspended concentrations in order to augment the sediment record for unsampled days and; b) provide some information on the way in which factors such as discharge, water temperature and antecedent conditions affect suspended concentrations. Predictive error and other model inadequacies were evaluated and the multiple regression alaysis generally provided the best results.

A partial duration series analysis has allowed the identification of the most significant types of events for soil erosion. The majority of these events coincide with spring melt and precipitation, although less significant events result from winter rain-on-snow and fall precipitation. Various probability distributions associated with the partial series analysis enable the sediment regime for the basin to be characterized. The results of this research indicate that further development of partial series analysis would be of benefit in analyzing the sediment yields for different basins.

DATA:

Primary Source; also refer to Water Survey of Canada data.

154. IRWIN, R.W. and LEWIS, J.A.
1971: Sedimentation in Floradale Reservoir, Ontario; University of Guelph, School of Engineering, Engineering Technical Publication, No. 20, 10p.

ABSTRACT:

A survey was made of sediment deposited in a reservoir on Canagagigue Creek. The sediment distribution within the reservoir showed that about 50 percent was located in the upper one-third of the reservoir. A particle size analysis showed that 50 percent of the bottom sediment was silt. The unit weight of the sediment varied with depth and location. The long term sediment yield of the watershed was calculated to be 47.3 tons per $km^2$/year.

DATA:

Primary Source.

155. JACKSON, T.A.
1979: The Geochemistry, Dynamics, and Distribution of Mercury in the Wabigoon-English River System: An Overview Report to the Steering Committee for the Canada-Ontario Study of Mercury Pollution in the Wabigoon River; Environment Canada, Inland Waters Directorate, National Water Research Institute, Western and Northern Region, W.N.R. - PR-79-1, 28p.

ABSTRACT:

A progress report for the first year of a continuing research project on the chemical speciation and dispersal of mercury (Hg) in the polluted Wabigoon River and associated lakes on Northwestern Ontario is presented, and the relevance of the results to possible pollution-abatement schemes is discussed. The study area extended from the town of Dryden (where Hg, wood fragments, and sewage had been discharged into the river) downstream to Ball Lake, and included Clay Lake and Wainwright Reservoir. The study focused on the following topics: (1) variations in the concentrations of monomethyl mercury ($CH_3Hg^+$) and other extractable chemical species of Hg in bottom sediments as functions of environmental variables; (2) the transport of Hg in general and $CH_3Hg^+$ in particular by the Wabigoon River during the spring flood of 1978, and the distribution of $CH_3Hg^+$ in Clay Lake and Ball Lake water in the summer of 1978; (3) the importance of bottom sediments in the river reservoir between Dryden and Clay Lake, compared with bottom sediments in Clay Lake and Ball Lake, as sources of $CH_3Hg^+$ for the overlying water; and (4) the distribution of Hg in the system, with particular attention to the absolute quantities of Hg trapped in the sediments of Wainwright Reservoir and the Wabigoon River as far downstream as Clay Lake.

DATA:

Primary Source.

156. JACKSON, T.A., PARKS, J.W., JONES, P.D., WOYCHUK, R.N., SUTTON, J.A. and HOLLINGER, J.D.
1982: Dissolved and Suspended Mercury Species in the Wabigoon River (Ontario, Canada): Seasonal and Regional Variations; Hydrobiologia, Vol. 92, p. 473-487.

ABSTRACT:

Seasonal and regional variations in the speciation, sediment-water partitioning, and dynamics of mercury (Hg) were studied at selected sites along the Hg-polluted Wabigoon River, and at unpolluted headwater and tributary sites, during April-September, 1979. 'Dissolved' and 'particulate' forms of Hg in the water were separated by continuous-flow centrifugation in the field. The Hg and other pollutants such as wood chips and salt had been discharged from the chlor-alkali plant and paper mill at Dryden, Ontario.

Concentrations and loadings of particulate methyl mercury ($CH_3Hg^+$) and total particulate Hg (and loadings of 'dissolved Hg) were greatest during the spring flood (April-May) owing to accelerated resuspension and transport of sediments. Concentrations of 'dissolved' $CH_3Hg^+$, however, were highest in

the summer (July-September), probably reflecting stimulation of microbial methylating activity by elevated temperatures, together with factors such as reduced levels of metal-scavenging particulates and minimal dilution by runoff. Total dissolved Hg concentrations were relatively high in September at polluted sites only, possibly because of desorption from sediments due to elevated concentrations of $Cl^-$ ions. Loadings of dissolved $CH_3Hg^+$ tended to be high in the summer but were generally depressed (suggesting sorption by suspended particles) during the major spring flood episode in May.

During July-August dissolved $CH_3Hg^+$ was a function of total dissolved Hg, suggesting rapid biomethylation of desorbed inorganic Hg; but in general dissolved and suspended $CH_3Hg^+$ levels depended on environmental variables and were unrelated to total Hg concentrations. In the summer only, total dissolved Hg was a function of dissolved $Cl^-$. Hg species in particulates were associated with sulfides, hydrated Fe and Mn oxides, organic matter (notably high molecular weight humic and humic-Fe components), and selenium (Se); but $CH_3Hg^+$ and total Hg differed in their specific preferences for binding agents, implying that binding sites discriminate between $CH_3Hg^+$ and $Hg^{2+}$ ions. $CH_3Hg^+$ was associated with sulfide and (in the spring only) with Fe oxides, whereas total Hg was associated with organic matter and Se and with DTPA- and NaOH-extractable Fe in the spring but with Mn oxide and NaOH-extractable organics in the summer. Sulfides were most abundant in May, indicating that they were eroded from bottom sediments, but Fe and Mn oxides were most abundant in the summer, probably owing to activities of filamentous iron bacteria and other micro-organisms.

Particulate Hg was 98-100% nonextractable by mild solvents such as Ca acetate, $CaCl_2$, dilute acetic acid, and (at polluted sites only) DTPA solutions, suggesting that the particulate Hg mobilized in the spring may not be readily available to organisms; association with Se and high molecular weight humic matter also supports this hypothesis. Hg probably becomes more bio-available in the summer, as suggested by the upsurge in dissolved $CH_3Hg^+$ and total dissolved Hg levels, and by increases in the solubility of particulate Hg in acetic acid, DTPA, $H_2O_2$, and NaOH solutions, as well as an increase in the relative importance of lower molecular weight fractions of NaOH-extractable Hg (in September).

Regional variations in Hg speciation and partitioning reflected a gradient in sediment composition from wood chips near Dryden to silt-clay mud further downstream. Hg in silt-clay mud relatively far ( 35 km) downstream from the source of pollution or in unpolluted areas appeared to be more readily solubilized by $Cl^-$ ions or chelators such as DTPA, more readily methylated (as indicated by downstream increases in dissolved $CH_3Hg^+$ levels and $CH_3Hg^+$/total Hg ratios), and was to a greater degree organically bound ($H_2O_2$-extractable), and thus was probably

more bio-available, than Hg in wood-chip deposits. Possible explanations include weaker binding of Hg by the mud, the more finely divided state of the mud, and improved microbial growth at lower concentrations of toxic pollutants. Owing to enrichment in sulfides and Fe oxides, resuspended wood-chip sediments were especially efficient scavengers of $CH_3Hg^+$.

The results indicate that in any pollution abatement plan aimed at lowering the Hg levels in the biota of lakes fed by the Wabigoon River, immobilization, removal, or detoxification of dissolved as well as particulate forms of Hg in the river would probably have to be considered. Possibly, Hg species could be 'scrubbed' from the river water by increasing the suspended load and by sedimentation and treatment with Hg-binding agents in special receiving basins.

DATA:

Primary Source.

157. KAISER, K.L.E., COMBA, M.E., HUNTER, H., MAGUIRE, R.J., TKACZ, R.J. and PLATFORD, R.F.
1985: Trace organic contaminants in the Detroit River; Journal of Great Lakes Research, Vol. 11, No. 3, p. 386-399.

ABSTRACT:

Concentrations of polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PNAs), chlorobenzenes (CBs), chlorophenols (CPs), and a number of other organochloring compounds (OCs) have been determined in the surface microlayer, subsurface water, suspended solids, sediments, and in sediment pore water at 20 sampling stations in the Detroit River. The data are discussed in terms of contaminant sources, pathways, and sinks. Spatial trends within the river and relationships of contaminant groups within and between compartments are described. The results indicate a continuing input of all contaminant groups to the river from a variety of sources, particularly from sewage treatment plant effluents and several tributaries. The contaminant distributions and intercorrelations also indicate that major sources of PCBs, PNAs, OCs, and CBs are concentrated on the westerly river shore, while CPs enter the river mainly from the easterly shore.

DATA:

Primary Source.

158. KAUSS, P.B.
1983: Studies of Trace Contaminants, Nutrients, and Bacteria Levels in the Niagara River; Journal of Great Lakes Research, Vol. 9, No. 2, p. 249-273.

ABSTRACT:

Sediment and water quality of the Niagara River were investigated during 1979 and 1980 to determine spatial and temporal differences in the levels of trace contaminants (heavy metals, phenolics, PCBs, and organochlorine pesticides) as well as nutrients and bacteria. Data from these studies as well as recent biomonitoring studies indicate that the Niagara River continues to be a source of such contaminants as PCBs, BHCs, mirex, and heavy metals to Lake Ontario. The major source of the contaminants is the highly industrialized and urbanized Tonawanda Channel area in the upper section of the river. Although a substantial improvement in phenolics levels was noted in the river since earlier surveys in 1971, bacterial and phosphorus levels show no significant changes, particularly near the U.S. mainland shore of the Tonawanda Channel and near the Buffalo River mouth.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

159. KAUSS, P.B., SUNS, K. and JOHNSON, A.F.
1983: Monitoring of PCBs in Water Sediments and Biota of the Great Lakes - Some Recent Examples; In: Physical Behaviour of PCBs in the Great Lakes, D. Mackay, S. Patterson, S.J. Eisenreich and M.S. Simmons, editors, Ann Arbor Science, p. 385-409.

ABSTRACT:

This paper indicates the types of monitoring and surveillance efforts being conducted by the Water Resources Branch and West-Central Region of the Ontario Ministry of the Environment (MOE) in the study of the impact, fact and temporal trends of PCBs in the Great Lakes nearshore environment. Some recent data on PCBs analysis of both abiotic and biotic samples are presented as samples of this work.

Examples from the MOE's fish contaminants monitoring programs in the Great Lakes (both sports and forage fish) are discussed, with respect to regional differences as well as temporal trends. Although the Niagara River is not the only source of PCBs to Lake Ontario, it is the major tributary, and trace contaminants carried by the river have been shown to impact Lake Ontario sediments and biota. Examples of water, sediments and biota studies being carried out in an attempt to delineate source areas of various trace contaminants in the river, including PCBs, are therefore included as well.

DATA:

Secondary Source; refer to Canada - Ontario Review Board (1980, 1981).

160. KEMP, A.L.W., DELL, C.I. and HARPER, N.S.
1978: Sedimentation Rates and a Sediment Budget, Journal of Great Lakes Research, Vol. 4, No. 3-4, p.276-287.

ABSTRACT:

Present-day sedimentation rate. were determined at 10 offshore locations, representative of the depositional basins in Lake Superior. Sedimentation rates were calculated by averaging the weight of sediment deposited above the Ambrosia pollen horizon, dated at 1890. The rates are variable ranging from a low of 25 g $m^{-2}$ $yr^{-1}$ (0.1 mm $yr^{-}$) to a maximum value of 780 g $m^{-2}$ $yr^{-1}$ (20 mm $yr^{-}$). Sedimentation rates were related to the proximity of terrestrial source, circulation patterns and bottom topography. The highest rates were found at locations closest to the edges of the depositional basins and at the base of steep-sided troughs. The present-day sedimentation rates were proportional to the postglacial sedimentation rates at almost every locality and were half the value of the postglacial rates.

A total of 6.029 million tons of fine-grained sediment is annually deposited in the lake. Erosion of the red clay bluffs of Wisconsin is the major sediment source accounting for up to 58% of the external input. Rivers contribute 30% of the external sediment load. It is calculated that the Duluth basin is the repository of 37% of the total present-day natural sediment loading to the lake.

DATA:

Primary Source; also refer to International Joint Commission (1977).

161. KEMP, A.L.W. and HARPER, N.S.
1976: Sedimentation Rates and a Sediment Budget for Lake Ontario; Journal of Great Lakes Research, Vol. 2, No. 2, p.324-340.

ABSTRACT:

Present-day sedimentation rates of fine-grained sediment were determined at 39 offshore locations in Lake Ontario. The sedimentation rates were calculated by averaging the weight of sediment deposited above the Ambrosia (ragweed) pollen horizon, dated at 1850. The rates are variable, ranging from a low of 85g $m^{-2}$ $yr^{-1}$ (0.3 mm $yr^{-1}$) to a maximum of 1225g $m^{-2}$ $yr^{-1}$

(2.2 mm $yr^{-1}$). Rates are highest at the eastern and western extremes of the main basin of the lake and appear to be related to littoral drift patterns. Mean sedimentation rates of 435, 260, 550, and 530g $m^{-2}$ $yr^{-1}$ are calculated for the Niagara, Mississauga, Rochester and Kingston Basins respectively.

A total of 4.8 million tons of fine-grained sediment is annually deposited in the lake. River inputs are the major source of the fine grained sediments with the Niagara River accounting for 50% of all incoming materials. Most of the suspended materials are deposited in the Rochester and Kingston Basins (38%) or are carried out of the lake via the St. Lawrence River (36%). This reflects the general eastward movement of the materials and their deposition either towards the outlet or their movement out of the lake.

DATA:

Secondary Source; refer to Water Survey of Canada data.

162. KEMP, A.L.W., MacINNIS, G.A. and HARPER, N.S.
1977: Sedimentation Rates and a Revised Sediment Budget for Lake Erie; Journal of Great Lakes Research, Vol. 3, No. 3-4, p. 221-233.

ABSTRACT:

Present-day sedimentation rates were determined at 50 offshore locations, representative of the depositional basins of Lake Erie. Sedimentation rates were calculated by averaging the weight of sediment above the Ambrosia and/or Pinus pollen horizons, dated at 1850. The rates are variable, ranging from a low of 0 g $m^{-2}$ $yr^{-1}$ to a maximum value of 6,450 g $m^{-2}$ $yr^{-1}$ (7.4 mm $yr^{-1}$). Sedimentation rates were highest in the western basin, near the mouths of Detroit and Maumee Rivers, and in the deepest parts of the eastern basin, east of Long Point. The high rates in the western basin are due to the large inputs of suspended solids from the Detroit and Maumee Rivers. Erosion of shoreline bluffs between Rondeau and Long Point is probably responsible for the high rates in the eastern basin. Mean sedimentation rates of 2,160, 580, and 1,340 g $m^{-2}$ $yr^{-1}$ are calculated for the western, central and eastern basins respectively.

A total of 14.3 million tons of fine-grained sediment is annually deposited in the lake. Erosion of shoreline bluffs is the major source of the sediment that is accumulating in the offshore basins, accounting for 40% of all incoming materials. Rivers are the second largest source, contributing 28% of the external sediment load.

DATA:

Primary Source; also refer to International Joint Commission (1969).

163. KETCHESON, J.W., DICKINSON, W.T. and CHISHOLM, P.S.
1973: Potential Contributions of Sediment from Agricultural Land; Proceedings of the Ninth Canadian Hydrology Symposium on Fluvial Processes and Sedimentation, University of Alberta, Edmonton, May 8-9, 1973, p. 184-191.

ABSTRACT:

Means by which agriculture may contribute sediment to stream systems have been identified as water erosion of soil from sloping fields and streambanks, and transport of material from the eroded slope to a stream. Runoff water from farm fields is also recognized as an active means whereby stream erosion might be accelerated and sediment load increased

Runoff and sediment data from small agricultural plots, fields, and various-sized watersheds in Southern Ontario have been presented to illustrate the possible contribution of agricultural land to sediment loads in streams. Whereas the peak movement of soil from the small plots was during summer, the peak sediment load carried by streams was during spring. These observations have been interpreted to mean that either a small proportion of soil eroded from fields reaches streams, or that a considerable lag between erosion and transport occurs.

Management os soils and crops was also recognized as a significant modifying factor in sediment production from agricultural land. Soil cover, as provided by growing crops and residue mulches, and by the maintenance of permanent vegetated buffer zones between cropped land and streams, was observed to reduce potential sediment yields.

DATA:

Secondary Source; refer to Water Survey of Canada data.

164. KING, W.A.
1980: The Geomorphological Sedimentology of the Lower Reaches of the Attawapiskat River, James Bay, Ontario. Unpublished M.Sc. Thesis, Department of Land Resource Science, University of Guelph, 214p.

ABSTRACT:

The modern environments, processes and sediments of the lower reaches of the Attawapiskat River have been analysed to elucidate the initiation, maintenance, and disruption of the river's anastomosing channel pattern. The relatively young (8000 years) subarctic river is entrenching into the emerging Hudson Bay Lowland. The stable multi-channel character is initiated in the intertidal and shallow subtidal zones. Several embryonic channels are formed by divergence of the river plume around highs in the resistant till substratum and around local modern coarse grained

deposits generated by ice-rafting. These channels are subsequently deepened by river flow and tidal currents. As the sea regresses, the channel banks are preferentially colonized and stabilized by vegetation. They undergo very little lateral migration and no new secondary channels are formed.

The river has a subarctic nival hydrologic regime. The lower reaches are influenced by mixed, semi-diurnal tides (2.36 m spring tide) which penetrate up to 7.5 km inland along the main channel. Side channels are flood tide dominated with brackish (13.2%) water penetrating up to 20 km inland. The river carries very little bedload but a sizable (94 mg/l) suspended sediment load, most of which is flushed into James Bay. Alluvial deposits are present as thin (2-4), narrow (150 m) levees; as occasional sandy bars which form in sheltered areas of islands and shoals; and as thin (5 cm) silty veneers on the floors of secondary channels. Near the coast, side channels are dept open by scouring during floods and by tidal currents. However, further inland (30 km) the more rapidly entrenching main channel captures theier flow, and the river becomes an irregularly meandering stream.

Pleistocene tills overlain by a Holocene regressive sequence are exposed in the river banks. The regressive sequence is composed of a lower subtidal, fossilferous clay-silt unit overlain sharply by tidal flat deposits of extremely variable lithology and texture. The intertidal deposits are overlain gradationally by silty marsh deposits with thin (0.1 cm) discontinuous organic-rich laminae plus lenticular sandy storm beds. The marsh grades upward into levee deposits characterized by thicker (0.2 cm) and more regular organic-rich laminae alternating with thin (1.5 cm) sandy silt beds. In rare instances, the till substratum is overlain by a totally alluvial sequence (2.5 m thick) characterized by ripple marked sandy bar deposits. These sediments grade upward into levee sediments of vegetated islands. Ice-rafted sediments commonly occur in all of the sedimentary environments.

Other anastomosing rivers reported in the literature reveal basic differences from the Attawapiskat River, such as crevassing and thick alluvial deposits. However, strong similarities exist which may be useful in interpreting deposits of ancient anastomosing streams. These similarities include high and abrupt lateral variability in texture, a predominance of overbank sedimentation, limited or negligible point bar deposits, and a lack of numerous in-channel bars.

DATA:

Primary Source.

165. KING, W.A. and MARTINI, I.P.
1984: Morphology and Recent Sediments of the Lower Anastomosing Reaches of Attawapiskat River, James Bay, Ontario, Canada; Sedimentary Geology, Vol. 37, No. 4, p. 295-320.

ABSTRACT:

The Attawapiskat River is one of the major low-gradient rivers which cross the flat wetlands of the Hudson Bay Lowland. It has a nival regime leading to strong, short-duration spring floods during which considerable amount of sediment is carried. For the remainder of the year only organic matter is transported in solution and suspension. The land is isostatically rebounding after the Pleistocene glaciations. The river downcuts through the softer Holocene estuarine basal clays and the Pleistocene tills, to the Paleozoic carbonate bedrock. The river develops an anastomosing pattern in the lower reaches and it acquires an irregular meandering character inland. It does not construct a significantly thick delta as the river-borne sediments are dispersed along the coasts by tides, longshore currents and ice rafting. The river is subjected to frequent ice jams in its lower reaches as warmer southern waters flow toward the still frozen mouth and sea. During the jams secondary channels become active, floodings develop and sedimentation occurs on the levees. Ice scours and ice-rafted materials affect the river banks greatly.

The principal sedimentary environments within the river consist of: (1) erosional shoals covered by boulder and pebble lags over till; (2) sorted coarse to medium-sized sands in junction bars downstream from islands; these sands frequently develop gas bubbles, and they contain characteristic fining-upward sequences from boulder pavements at the base, grading up into ripples and with abundant organic matter, grading up into laminated silt and sand and organic matter; (3) secondary channels, which develop thin silty and clay drapes on eroded hard substratum and are filled eventually by thick peats; and (4) river banks which show well-developed regressive sequences from Pleistocene tills at the base, overlain by estuaring sparsely fossilferous clays, capped by thin conglomperatic units with abundant reworked Macoma balthica shells, grading upward into upper tidal flat sand, irregularly laminated sand and silt of marshes, and regular interbedding of sand, silt and organic layers of the levees at the tope.

DATA:

Secondary Source; refer to King (1980).

166. KITCHEN, B.W.
1969: Reservoir Sedimentation; Report prepared for the Department of Co-Ordination and Placement, Department of Energy, Mines and Resources, Guelph, 30p.

ABSTRACT:

This report is a definition of sedimentation as it affects reservoirs. Two types of surveys are described and information from Indian and United States studies are included along with a hypothetical calculation for the useful life of the Lake Conestogo Reservoir. The procedure followed at Lake Conestogo during the autumn of 1969 is outlined in a section concerning the capacity survey method. The investigation is concluded by giving some generalized concepts used in reservoir design, and a short examination of a secondary effect due to sedimentation.

DATA:

Secondary Source; refer to Water Survey of Canada data.

167. KLASSEN, R.A. and SHILTS, W.W.
1982: Subbottom Profiling of Lakes of the Canadian Shield; Turkey Lakes Watershed Unpublished Report No. TLW-82-08, 10 p. Also: Current Research, Part A, Geological Survey of Canada, Paper 82-1A, p. 375-384, 1982.

SUMMARY:

Subbottom profiling of the sediments in Turkey Lake and Little Turkey Lake (and 11 others in Eastern Ontario and Quebec) using an acoustic profiler is reported. Profiles showed that many lake bottoms are filled with more than 25 m of lake glacial sediment which is generally covered in turn by up to 5 m of modern gyttja - like lake sediment.

DATA:

Primary Source.

168. KNAP, K.M. and MILDNER, W.F.
1978: Streambank Erosion in the Great Lakes Basin; Report, Task Group C, Activity 6, PLUARG, International Joint Commission, Windsor, 29 p.

ABSTRACT:

The main conclusions are:

1. The amount of sediment produced from streambank erosion can vary from basin to basin, season to season and year to year. It is also noted that the total amount of material eroded is not large when viewed on a global or continental scale.

2. When viewed relative to other sources of sediment, bank erosion does not appear to be a major contributor, accounting for 1 to 10% of the load in the U.S. study watersheds and 2 to 32% in the Canadian basin.

3. total phosphorus is the most important chemical contributed from bank erosion. An estimated 426,000 kg of phosphorus are added to the Great Lakes each year from eroding banks.

4. While downstream sections of rivers were not specifically included in the Canadian study watersheds they were in U.S. study basins. There seem to be higher or lower than other areas.

In the Canadian basins several other conclusions have been reached:

1. The source areas of bank erosion within each watershed can be highly variable and both point and non-point in nature.

2. From observations in the field a list of natural and cultural factors contributing to bank erosion has been compiled. Some of the main physical causes are sheet and rill erosion by overland flow and scouring by the stream often followed by slumping of the upper bank under gravity.

3. The above factors vary from area to area with some regions of the province having a combination of factors that would suggest higher or lower sediment yields from bank erosion.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

169. KONASEWICH, D., TRAVERSY, W. and ZAR, H.
1978: Great Lakes Water Quality Status Report on Organic and Heavy Metal Contaminants in the Lake Erie, Michigan, Huron and Superior Basins; Report to the Implementation Committee of the Great Lakes Water Quality Board, International Joint Commission, Windsor, 373 p.

ABSTRACT:

Early in 1978, the Great Lakes Water Quality Board directed its Implementation Committee to prepare a report which sould: review available data on the distribution and bioaccumulation of "toxic materials" in the basins of lake Erie, Huron, Superior and Michigan; define the necessary future programs to assess the degree of contamination in the basins; and, recommend future data collection, financial and technical assistance to conduct necessary programs and measures to protect the public health and resources of Lake Erie, Huron, Superior and Michigan. A report for Lake Ontario was prepared in 1976.

This report to the Implementation Committee is an inventory of organic and heavy metal contaminants which have been detected in the basins of lakes Erie, Huron, Superior and Michigan.

Subsequently, under the auspicies of the Implementation Committee, the identified contaminants will be evaluated to determine which, if any, may have potential effects on human health and the environment. Recommendations for future programs will then be developed.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

170. KRANCK, K. and RUFFMAN, A.
1982: Sedimentation in James Bay, Naturaliste Canadian, Vol. 109, No. 3-4, p. 353-361.

ABSTRACT:

The sedimentary regime of James Bay is examined on the basis of published and unpublished data. Rivers are estimated to bring $4.12 \times 10^7$ tons per year of sediment to the bay. A large portion of this is deposited near shore but silt and clay transported offshore have formed a nearly continuous mud deposit over the bay bottom. Suspended sediment levels in the bay are relatively high, estimated to range from 1 to 100 mg/L. Concentrations decrease from the head of the bay northward, and at the boundary with Hudson Bay decrease sharply. A counterclockwise current circulation transports sediment towards the northeastern entrance of the bay.

DATA:

Secondary Source; refer to Stichling (1973).

171. KUDO, A.
1976: Mercury Transfer from Bed Sediments to Freshwater Fish (Guppies); Journal of Environmental Quality, Vol. 5, No. 4, p.427-430.

ABSTRACT:

Mercury transfer from river sediments to freshwater fish (Lebistes reticulata) (wet weight, 29 to 869 mg) was observed for 150 days.

Release rate from the sediment indicates a half-life of 12 to 20 years. The amount taken up the fish varied widely (up to 600% differences), but half-lives for clearance were all between 38 and 75 days. No correlation was found between mercury uptake rate and either size or sex of fish.

DATA:

Primary source.

172. KUDO, A., AKAGI, H., MORTIMER, D.C. and MILLER, D.R.
1977: Equilibrium Concentrations of Methylmercury in Ottawa River Sediments; Nature, Vol. 270, No. 5636, p. 419-420.

ABSTRACT:

This article describes how methylmercury equilibrium concentration levels in the Ottawa River sediments are used to estimate the amount of methymercury in various types of bed sediment where detailed information of total mercury concentrations (total mercury estimation 31 kg) and types of sediment is available. Two ways (methylmercury production and degradation) or reaching equilibrium were observed during 50 days in identical environmental conditions. Thin layer chromatography and atomic absorption spectrometry were used to determine the quantities of the various chemical forms of mercury, mainly mercuric and methylmercuric, as well as the total mercury in sediments. The calculations made showed that methylmercury existing in the sediments was higher by at least two orders of magnitude, than those in the biomass.

DATA:

Primary Source.

173. KUDO, A. and HART, J.S.
1974: Uptake of Inorganic Mercury by Bed Sediment; Journal of Environmental Quality, Vol. 3, No. 3, p. 273-278.

ABSTRACT:

The kinetics of uptake of inorganic mercury as mercuric chloride by a variety of freshwater river sediment types typical of Ottawa River sediments were studied to determine the influence of mercury concentration in water, hydrodynamic effects, sediment depth, aerobic or anaerobic conditions, and two types of water. Uptake appears to depend strongly on concentration of mercury in water and water velocity, and not on sediment depth or water type. No significant difference in uptake rates was observed between aerobic and anaerobic conditions during the 10 days studied.

DATA:

Primary Source.

174. KUDO, A., MILLER, D.R., AKAGI, H., MORTIMER, D.C., DeFREITAS, A.S., NAGASE, H., TOWNSEND, D.R. and WARNOCK, R.G.
1978: The Role of Sediments on Mercury Transport (Total- and Methyl-) in a River System; Progress in Water Technology, Vol. 10, No. 5-6, p. 329-339.

ABSTRACT:

Suspended sediments (solids) contribute 58% (982 kg per year) of all mercury transported downstream in the study section of the Ottawa River. Although filtered water contains a low mercury concentration (13 ng/l or 0.013 ppb), it accounts for 41% (689 kg per year) of all mercury transported downstream. The role of bed sediment movements on the mercury transport is very small, only 1%, in the study section. Most of the mercury (96.7% of total mercury and 97.% of methylmercury) is in bed sediments. Biomass contains an insignificant portion of mercury (0.2% of total mercury and 1.7% of methylmercury), though it has a higher ratio of methylmercury to total mercury; plants (20%), invertebrates (40%) and fish (85%). Methylmercury production and destruction are in equilibrium in water and sediments without biological agents, such as higher aquatic plants, invertebrate and fish.

DATA:

Primary Source.

175. KUDO, A., MILLER, D.R. and TOWNSEND, D.R.
1977: Mercury Transport Interacting with Bed Sediment Movements; Progress in Water Technology, Vol. 9, No. 4, p. 923-935.

ABSTRACT:

This paper summarizes the results of field surveys related to mercury concentration and distribution in the Ottawa River. Special emphasis is given to a study of mercury (inorganic and organic forms) transport by bed sediment movements using a 9.17 m laboratory flume. Also included is a bed supporting study on sediments interacting with mercury.

DATA:

Primary Source; also refer to Kudo and Hart (1974), Kudo et al. (1975) and Mortimer and Kudo (1974).

176. KUDO, A.,, MILLER, D.R., TOWNSEND, D.R. and SAYEED, H.
1975: Laboratory Investigation of Mercury Transport Through Bed Sediment Movements; In: Environmental Biogeochemistry, Volume 2, Metals Transfer and Ecological Mass Balances, J.O. NRIAGU, editor, Ann Arbor Science, p. 499-511.

ABSTRACT:

This paper summarizes the initial results of flume studies on mercury transport by bed sediment movements.

DATA:

Primary Source.

177. KUDO, A. and MORTIMER, D.C.
1979: Pathways for Mercury Uptake by Fish from Bed Sediments; Environmental Pollution, Vol. 19, No. 3, p. 239-245.

ABSTRACT:

Mercury transfer from bed sediments to freshwater fish was observed for 20 days in the laboratory. Organic-rich sediments from the Ottawa River were contaminated with mercuric chloride to produce a total mercury concentration of 1.023 pp.

Two possible mercury routes from bed sediments to fish were quantitatively evaluated. The concentration of mercury accumulated in fish from bed sediments was nine times higher than that accumulated from water in which mercury had come from bed sediments. The mercury concentration in individual fish varied considerably.

DATA:

Primary Source.

178. KUDO, A., MORTIMER, D.C. and HART, J.S.
1975: Factors Influencing Desorption of Mercury from Bed Sediments; Canadian Journal of Earth Sciences, Vol. 12, No. 6, p. 1036-1040.

ABSTRACT:

The desorption rate of mercury from bed sediments was determined by a 10 week experiment. The rates ranged from 0.1 ng/cm$^2$/day to 1.0 ng/cm$^2$/day for Ottawa River bed sediments, depending on the environmental conditions. The rates decreased with an increase of exposure period to the water, but increased with an increase in the depth of bed sediments. The amount of mercury desorbed from bed sediments to overlying water was highly dependent on the volume (depth) of bed sediments. Calculations based on the experiment showed the half-lives of total mercury associated with bed sediments from as short as 2.1 years to as long as 1.8 x 10$^2$ years, depending on the depth of the bed sediments.

DATA:

Primary Source.

179. KUDO, A., MORTIMER, D.C., TOWNSEND, D.R. and MILLER, D.R.
1977: Sorption, Desorption and Partitioning of Mercury in Bed Sediments; In: Distribution and Transport of Pollutants in Flowing Water Ecosystems, D.R. Miller, editor, Final Report of the Ottawa River Project, p. 8.1-8.45.

ABSTRACT:

A comprehensive programme of field studies on a 4.9 km reach of the Ottawa River indicates that approximately 97 percent of total mercury in the system is associated with the bed sediment materials. Detailed analyses of samples show that distribution and concentration of mercury in the sediments are predominantly functions of both material type and particle size with high concentrations associated with organic matter and fines. While biomass, (which includes fish, invertebrates, and plants), accounts for negligible amounts of mercury (approximately 0.02 percent), this component is nevertheless a major source of organic mercury in the river. Mercury concentration in water is extremely low compared to the other components, however water plays a major role in mercury transport. Mercury partition coefficients, between river water and sediments, averaged 5485 for wood chip sediments and 2091 for sand sediemtns respectively. Mercury partition coefficients vary widely among the basic sediment components. Average values for these components are given. It is possible to predict mercury concentrations in sediments with reasonalbe accuracy using partition coefficients and the mercury concentration in water. For Ottawa River sediments, the ratio of mercury concentration (field average/predicted value) were 1.16 (sands) and 1.20 (wood chips) for 1972, and 1.00 (sands) and 2.06 (wood chips) for 1973.

DATA:

Primary Source.

180. KUDO, A., TOWNSEND, R.D. and MILLER, D.R.
1977: Prediction of Mercury Distribution in River Sediments; Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol. 103, No. EE4, Proceedings Paper 13128, p. 605-614.

ABSTRACT:

Field studies on a 4.9 km reach of the Ottawa River confirmed that mercury in the system is almost completely (approx. 97 percent) associated with the bed sediments. However, mercury concentration varies widely in the study section and is a function of particle size and type of sediments. A laboratory study, in which the distribution of radioactive mercury among various sediment components was monitored under dynamic conditions, does lead to predictions of mercury concentrations that closely match observed field values. Sediments with high organic content, in particular the wood chips and fiber deposits common in the Ottawa River, have associated with them 50 times the amounts of mercury associated with sand particles on a weight per weight basis. The results emphasize the importance of performing material classification and binding affinity analysis.

DATA:

Secondary Source; refer to Miller (1977) and Kudo et al. (1976).

181. KUNTZ, K.W.
1984: Toxic Contaminants in the Niagara River 1975-1982; Environment Canada, Inland Waters Directorate, Ontario Region, Water Quality Branch, Technical Bulletin No. 134, 47 p.

ABSTRACT:

Between 1975 and 1982, Water Quality Branch, Ontario Region, collected water quality samples in the Niagara River system. This report summarizes the results obtained for toxic contaminants and trace metals from these monitoring activities. Various types of samples, including unfiltered water samples, suspended and bottom sediments and spottail shiners (Notropis hudsonius), have been analyzed for these constituents. In addition, large-volume (200 L) aqueous phase water amples were extracted for toxic organic contaminants. Data have been subdivided into major categories: (1) data collected at a single fixed station at Niagara-on-the-Lake and (2) data collected at various survey stations throughout the Niagara River system. Violations to the 1978 Great Lakes Water Quality Agreement specific objectives or Ontario Ministry of the Environment guidelines are indicated, and loadings to Lake Ontario have been calculated and presented.

DATA:

Primary Source.

182. KUNTZ, K., CHAN, C.H., CLIGNETT, A.H., and BOUCHER, R.
1982: Water Quality Sampling Methods at Niagara on the Lake; Internal Report, Environment Canada, Inland Waters Directorate, Ontario Region, 15p.

ABSTRACT:

The purpose of this report is to describe the program, the sampling system used and to document the changes which occurred to this project over the years.

DATA:

Secondary Source.

183. KUNTZ, K.W. and WARRY, N.D.
1983: Chlorinated Organic Contaminants in Water and Suspended Sediments of the Lower Niagara River; Journal of Great Lakes Research, Vol. 9, No. 2, p. 241-248.

ABSTRACT:

Suspended sediment and raw water samples have been collected and analyzed for organochlorines and PCBs from a fixed location in the

lower Niagara River at Niagara-on-the-Lake approximately weekly since 1979. Eight of the 19 organochlorine compounds measured were detected in more than 50% of the water samples analyzed, while 11 of the 19 compounds were detected in more than 50% of the suspended sediments collected at Niagara-on-the-Lake. Of the 10 chlorobenzene isomers measured, the one with the greatest usage (1,4-dichloro) occurs in largest concentrations in the suspended sediments at Niagara-on-the-Lake. Other chlorobenzene isomers commonly occurring in suspended sediments are 1,2 and 1,3 dichloro, 1,2,4-trichloro, 1,2,3,4-tetrachloro, pentachloro, and hexachloro. All isomers of chlorobenzene occurred in more than 70% of the suspended sediment samples collected. Total loadings to Lake Ontario calculated from these data indicate that PCB loadings are about twice as high as previously reported, while mirex and total DDT have decreased slightly. Although concentrations of contaminants in suspended sediments are usually higher than those measured in water samples, they are responsible for only about 40% of the total loadings for PCBs, DDT, and HCB, and significantly less for other organochloringe contaminants. Therefore, the data indicate that, to estimate total contaminant loadings, the water fraction must be sampled. Lake Erie is not the major source or such organic contaminants as PCBs and chlorobenzenes because contaminant levels in Lake Erie bottom sediments are 10 times lower for PCBs and 20 times lower for chlorobenzenes than in Niagara-on-the-Lake suspended sediments.

DATA:

Secondary Source; refer to Water Survey of Canada data (Water Quality data).

184. KUSHNER, D.J.
1974: Microbial Dealings with Heavy Metals; Proceedings of the International Conference on Transport of Persistant Chemicals in Aquatic Ecosystems, Ottawa, May 1-3, 1974, P. II59-II63.

ABSTRACT:

Occurence of $Hg^{++}$-resistant bacteria in water and sediment from the Ottawa River and in slime and gut contents of fish from this river are described. Half or more of the bacteria in all compartments were resistant to 10 ppm $Hg^{++}$. these bacteria could transform $Hg^{++}$ into a volatile compound, probably metallic Hg. No evidence was found for organic Hg formation. Problems of determining the site of methyl mercury formation in natural water systems are discussed.

Preliminary experiments are described which show the capacity of products from blue-green algae to bind $Pb^{++}$ ions.

DATA:

Primary Source.

185. LARSEN, C.R.
1978: Stream Sediment and Soil Geochemistry of an Area of Paleozoic Formations in Southeastern Ontario; Unpublished M. Sc. Thesis, Department of Geological Sciences, Queen's University, Kingston, 360 p.

ABSTRACT:

The recent awareness of possible energy shortages in the near future has created a heightened interest in uranium as an energy exploration effort for this commodity. If this exploration is to be successful, new and improved techniques applicable in the newly discovered favourable geological environments must be developed. One of these recently recognized favourable environments for hosting uranium mineralization is the Paleozoic Formations of Southeastern Ontario. This area is flat to slightly undulating, contains very few lakes, and frequent small streams despite the poorly developed drainage system. Overburden in the area consists of a generally thin cover of glacial material which has undergone some soil development since glaciation. In this area, or similar areas, the stream sediment or soil composition may be indicative of uranium mineralization by containing diagnostic geochemical characteristics, which if identified could be used in a reconnaissance and/or detailed scale uranium exploration program.

With this in mind a stream sediment orientation survey was conducted in the vicinity of the South March mineralized zone. Investigations were conducted to identify the optimum size fraction, density fraction, organic fraction, digestion procedure and analytical technique. Based on the results of this orientation survey, the results of the soil orientation studies carried out by the Geological Survey of Canada in the vicinity of the South March mineralization, and discussions with geochemists at the Survey and at Queen's University, a geochemical exploration program was conducted utilizing 2162 stream sediment samples, 566 follow-up stream sediments and 629 soils, collected over 1500 square miles. The minus 80 mesh fraction of these samples was analyzed for Cu, Pb, Zn, Ni, Co, Ag, Mn, and Fe by atomic absorption. The reconnaissance samples were analyzed for uranium by fluorimetry while uranium in the follow-up samples was determined by neutron activation. Using various statistical techniques including histograms, correlation coefficients, X-Y plots and stepwise linear regression, including the uranium residuals, the single element distributions and the geology, five zones containing consistent anomalous concentrations of U and Cu in both the sediments and soils were discovered. Particular areas within these zones were suggested to have a high potential for hosting U-Cu mineralization of the South March type. It was suggested that further investigations in the form of more detailed soil studies and subsequent detailed geological, radiometric and/or radon detecting investigations be carried out in these favourable zones.

It is concluded from this study that fluorimetric quenching is insignificant in this area. It is also concluded that dry sieved minus 80 mesh fraction is as effective if not more effective at distinguishing anomalous from background sediments as any other fraction investigated. It is concluded, however, that the humic acid component of the organic material may be useful in distinguishing anomalous from background sediments, however due to the involved separatory process necessary to obtain this fraction it has limited use in exploration. It is concluded that a weak acid digestion, such as an acetic acid-hydrogen peroxide mixture or nitric acid, followed by the analysis of the acid solution by either neutron activation or fluorimetry would result in excellent distinction between anomalous and background sediments and therefore is recommended in any future programs in this, or similar geological environments. It is recommended that neutron activation analysis be employed due to its superior analytical precision. It is also recommended that stepwise linear regression be conducted on all data, not just the reconnaissance data as in this study, in order to determine which variables are related to the U and/or Cu distribution and which residuals are most likely related to mineralization. It is concluded that only the U, Cu single element and U residuals distribution maps are significant with respect to mineralization and therefore are the only metal distribution maps that need necessarily be constructed. It is recommended that the organic content of the samples be taken into consideration when evaluating the significance of the metal concentration in the sample. It is suggested that if data, collected in a manner similar to that done in this study, is treated in the above manner the results would be very significant with respect to mineralization, and would be very effective at distinguishing anomalous from background samples in this and possibly similar geological environments.

DATA:

Primary Source.

186. LAUBE, V., RAMAMOORTHY, S. and KUSHNER, D.J.
1979: Mobilization and Accumulation of Sediment Bound Heavy Metals by Algae; Bulletin of Environmental Contamination and Toxicology, Vol. 21, No. 6, p. 763-770.

ABSTRACT:

A multi-compartmental approach is used to examine the inter-compartmental interactions and distributions of cadmium and copper in river water, sediment and algae in water samples from the Ottawa River, Ontario. Results indicate that cadmium and copper present in sediments, can be accumulated in substantial amounts by algae in separate compartments. This suggests that in natural systems algae may play a very important role in mobilizing sediment-bound heavy metal ions.

DATA:

Primary Source.

187. LEE-WAH, W.C.
1983: Heavy Metal Contamination of Suspended Sediment in the Don River, Southern Ontario; Unpublished B.A. Thesis, Department of Geography, University of Waterloo, Waterloo, 87 p.

ABSTRACT:

Not available at time of publication.

188. LEHN, M.
1982: Erosion and Sediment Control on Urban Residential Construction Sites: A Case Study in the City of Waterloo, Ontario; Unpublished B.A. Thesis, Department of Geography, University of Waterloo, Waterloo, 127 p.

ABSTRACT:

Not available at time of publication.

189. LEWIS, J.A.
1968: Sediment Movement in Canagagigue Creek Watershed Above Floradale Dam; Unpublished M.Sc. Thesis, Department of Agricultural Engineering, University of Guelph, Guelph, 203 p.

ABSTRACT:

Not available at time of publication.

190. LIMNO-TECH INC.
1985: Summary of the Existing Status of the Upper Great Lakes Connecting Channels Data; Report prepared for the Upper Great Lakes connecting Channels Study, 156 p.

SUMMARY:

This report summarizes the existing status of the Upper Great Lakes Connecting Channels data. This includes three objectives: 1) to compile and document sources of data; 2) to synthesize data on specific subject area relavent to the UGLCC study and 3) to identify information gaps.

DATA:

Secondary Source.

191. LUM, K.R. and GAMMON, K.L.
1985: Geochemical Availability of Some Trace and Major Elements in Surficial Sediments of the Detroit River and Western Lake Erie; Journal of Great Lakes Research, Vol. 11, No. 3, p. 328-338.

ABSTRACT:

Surficial bottom sediment from twenty locations in the Detroit River and western Lake Erie has been analyzed for potentially available Ba, Be, Cd, Co, Cu, Pb, Mn, Ni, P, V, and Zn. The highest concentrations of all but one of these elements were found at a station at the riverlake interface very close to a dumping ground. The environmental mobility of Cd, An, Co, Pb, CR, Ni and P is controlled by hydrous iron oxides, whereas V and Mo is controlled by aluminosilicates. The iron oxide phase exhibits a very high sorption capacity for phosphorus (molar adsorption coefficient = .361) which is attributed to the high loadings of Fe and P at the confluence of the Rouge and Detroit rivers as well as continuous inputs along the length of the Detroit River. It is suggested that phosphorus controls instituted in the 1970s will probably result in the iron oxide phase having greater sorption capacity for toxic metals because of the decreasing competition from phosphorus for binding sites.

192. LUSH, D.L. and HYNES, H.B.N.
1978: Particulate and Dissolved Organic Matter in a Small Partly Forested Ontario Stream; Hydrobiologia, Vol. 60, No. 2, p. 177-185.

ABSTRACT:

Weekly measurements during the open season at five stations on a small Ontario stream system showed that the size distribution of fine particles in the water varied irregularly. In general, rainfall increased their total amount and also the concentration of dissolved organic carbon. Clearly other local factors affect the supply of particles, and each reach behaves individually and may react differently to successive storms. The behaviour of dissolved material is more predictable, and it is clear that much is rapidly removed from solution. It was shown that high concentrations of particles are associated with high amounts of plant pigments, carbohydrate, and protein. Similarly dissolved carbohydrate and protein are raised when rain increases dissolved organic carbon. These findings suggest a series of mechanisms by which a woodland stream may trap woodland produced energy and cycle it through the aquatic system.

DATA:

Primary Source.

193. MacNABB, I.D.
1981: Watershed Environment Monitoring Program: A Case Study; In: Watershed Planning and Management, Some Papers From The Annual, Summer And Fall Meetings of the Ontario Chapter, Soil Conservation Society of America, Summer Meeting, June 9-10, 1978, London, p. 40-49.

ABSTRACT:

Since 1965 the Metropolitan Toronto and Region Conservation Authority has sampled the rivers under its jurisdiction on a monthly basis for water quality analysis by the Ministry. In 1976 the authority initiated a review of its water and related land management plan. One component of this review is the watershed environmental monitoring program, its goal being to develop the ability to predict the impact of the Metropolitan Toronto and Region Conservation Authority works, including dam construction channelization, an on river bank stabilization, on the environmental regime of a watercourse. Examinations at 27 sampling stations in 1977 involved water quality, sediment grain size and quality, and invertebrate sampling. By this means, changes in the aquatic environment brought about by the presence of authority structures on a watercourse were documented. A series of special studies involving temperature-oxygen relationships within reservoirs and at aeration weirs and water quality changes during rainstorm events, were undertaken to fully document the environment regime. The results of the program, which from a baseline upon which impact predictions ar future work sites can be made are discussed. Details are also given of the two special studies conducted on temperature-oxygen relationships at the Clairville Reservoir and at the Woodbridge Aeration Weir. The 1978 watershed environmental monitoring program is described and the financing of the program is discussed.

DATA:

Primary Source.

194. MacNEILL, N.
1985: Sediment Investigations of Fertilized Lakes in Algonquin Provincial Park, Ontario; Unpublished M.Sc. Thesis, Department of Biology, University of Waterloo, Waterloo, 217 p.

ABSTRACT:

This study involved a paleolimnological investigation of lakes in Algonquin Provincial Park, Ontario, to determine if perturbations induced by a fertilization experiment in the 1940's and recent cultural disturbances could be identified in the lake sediment profiles.

Pb-210 and Cs-137 dating analyses were performed to establish a chronology for the sediments and although they corroborated closely Pb-210 proved most reliable and dated closest to perceived events in the sediment cores.

Thin sediment sections were examined for biological and chemical parameters. Fossil diatoms proved most sensitive to recording changes documented from the fertilization experiment. Iron

concentrations best reflected perturbations in the watershed, and lead and zinc provided evidence of non-local influences upon the lakes from atmospheric deposition of heavy metals.

DATA:

Primary Source.

195. MAGUIRE, R.J.
1984: Butyltin Compounds and Inorganic Tin in Sediments in Ontario; Environmental Science and Technology, Vol. 18, No. 4, p.291-294.

ABSTRACT:

A method has been developed for the analysis of butyltin species and inorganic tin in sediments, and the presence of these compounds in sediments in Ontario is reported for the first time. Although inorganic tin occurred frequently in sediments collected around the province, butyltin species were found mainly in the sediments of harbors, reflecting earlier findings on their occurrence in water, with which these findings are compared. Tri-n-butyltin, the most toxic of the butyltin species to aquatic life, was present at 0.5 mg/kg (dry weight) in the top 2 cm of sediment in Toronto Harbour. In addition, tri-n-butylmethyltin and di-n-butyldimethyltin were found in the sediment of a few harbors, indicating that some buytltin species can be methylated in aquatic environments.

DATA:

Primary Source.

196. MAGUIRE, R.J., KUNTZ, K.W. and HALE, E.J.
1983: Chlorinated Hydrocharbons in the Surface Microlayer of the Niagara River; Journal of Great Lakes Research, Vol. 9, No. 2, p. 281-286.

ABSTRACT:

Concentrations of 18 chlorinated hydrocarbons were determined in the surface microlayer, subsurface water, and suspended solids at five stations along the length of the Niagara River in July 1981. The concentration of heptachlor epoxide in the unfiltered surface microlayer was greater than that in unfiltered subsurface water at all five stations be factors of 138 to 225; alphendosulfan and "total PCB" were similarly enriched in the surface microlayer at two stations each, by factors of up to 203 and 32, respectively. In addition, mass balances for the 18 compounds in the three "compartments" sampled showed that (i) at three stations there was more heptachlor expoxide in the unfiltered surface microlayer than associated with those suspended solids which were collected with a continuous flow separator from a depth of 1 to 2 m, and (ii) there

was far more alpha- and gamma- BHC, dieldrin, and "total PCB" present in unfiltered subsurface water than associated with the suspended solids. This latter finding in particular necessitates a revision of earlier estimates of loading of at least some chlorinated hydrocarbons to Lake Ontario from the Niagara River, based solely on concentrations in the suspended solids fraction sampled with the same continuous flow separator.

DATA:

Primary Source.

197. MAGUIRE, R.J. and TKACZ, R.J.
1985: Degradation of the Tri-n-butyltin Species in Water and Sediment from Toronto Harbor; Journal of Agricultural and Food Chemistry, Vol. 33, No. 5, p.947-953.

ABSTRACT:

Contamination of water and sediment in Toronto Harbor by the highly toxic tri-n-buytltin species ($Bu_3Sn^+$) and its less toxic degradation products, the di-n-butyltin species ($Bu_2Sn^{2+}$), n-butyltin species ($BuSn^{3+}$), and inorganic tin, is demonstrated. At some locations the concentration of $Bu_3Sn^+$ in water is high enough to warrant concern with regard to chronic toxicity to sensitive organixms. The $Bu_3Sn^+$ species (i) is bound fairly strongly to sterile Toronto Harbor sediment and the half-life of desorption is at least 10 months at 20°C, (ii) can be taken up from sediment and degraded by oligochaetes, and (iii) is degraded by a sequential debutylation pathway at 20°C in Toronto Harbor water and water sediment mixtures with half-lives of 5 and 4 months, respectively. On the basis of this and earlier work it is concluded that the main factors limiting the persistence of the tri-n-butyltin species in aquatic ecosystems are photolysis in water and biological degradation in water and sediment, and with the temperatures and sunlight intensities prevalent in Canada, the half-life is likely to be at least a few to several months.

DATA:

Primary Source.

198. MAGUIRE, R.J., TKACZ, R.J., CHAU, Y.K., BENGERT, G.A. and WONG, P.T.S.
1986: Occurence of Organotin Compounds in Water and Sediment in Canada; Chemosphere, Vol. 15, No. 3, p. 253-274.

ABSTRACT:

Water and sediment samples from 265 locations across Canada were analyzed for buytltin and methyltin species, and inorganic tin.

In 10% of the water samples the highly toxic tributyltin species was found at concentrations which could cause growth retardation upon chronic exposure to a sensitive organism, rainbow trout yolk sac fry. High concentrations of tributyltin were found in some sediments (up to 10 mg Sn/kg dry weight), but the biological availability of sediment-associated tributyltin is unknown. Tributyltin was mainly found in areas of heavy boating and shipping traffic, which is consistent with its use as an antifouling agent in some paints for boats, ships and docks. The methyltin species were found much less frequently in water and sediment than tributytin and its degradation products.

DATA:

Primary Source.

199. MAGUIRE, R.J., TKACZ, R.J. and SARTOR, D.L.
1985: Butyltin Species and Inorganic Tin in Water and Sediment of the Detroit and St. Clair Rivers; Journal of Great Lakes Research, Vol. 11, No. 3, p. 320-327.

ABSTRACT:

Water and sediment samples from 29 locations in the Detroit and St. Clair rivers were analyzed for the highly toxic tri-n-butyltin ($Bu_3Sn^+$) species and for the less toxic di-n-butyltin ($Bu_2Sn^{2+}$) and n-butyltin ($BiSn^{3+}$) species and inorganic tin. In general, locations sampled in the St. Clair River were less contaminated with butyltin species than those in the Detroit River. Inorganic tin and $BuSn^{3+}$ were detected in over 90% of all subsurface water samples, while $Bu_2Sn^{2+}$ and $Bu_3Sn^+$ were detected in 45 and 28% of the same samples, respectively. The highest concentration of $Bu_3Sn^+$ in subsurface water, $5.9 \times 10^{-10}$ mol Sn/L, was at the mouth of the Ecorse River, a tributary of the Detroit River. The three butyltin species and inorganic tin were also detected in 23-46% of all sediment samples. The highest concentrations of $Bu_3Sn^+$ in sediment were found close to the mouths of the River Rouge, another tributary of the Detroit River, and the Ecorse River, and were $6.2 \times 10^{-7}$ and $1.7 \times 10^{-7}$ mol Sn/kg dry weight, respectively for the top 2 cm of sediment.

DATA:

Primary Source.

200. MANDELBAUM, H.
1966: Sedimentation in the St. Clair River Delta; Proceedings of the Ninth Conference on Great Lakes Research, Chicago, Illinois, March 28-30, 1966, p. 192-202.

ABSTRACT:

680 sediment samples from 124 cores, taken in the area north of the St. Clair Flats Channel, are analyzed and the parameter distribution of these samples studied. The average grain size of the deltaic sediment is .11 mm, but all parameters of the size distribution of grains show a wide range of variation. The areal distribution of skew parameters shows significant tendencies for the upper end and lower end of the bays. It is concluded that the solid material brought in by the main channels into the delta area is in the average much finer than the average delta sediment and that only about two-thirds of this material is retained as permanent sediments in the delta.

DATA:

Primary Source.

201. MANNING, P.G. and ASH, L.A.
1979: Mossbauer Spectral Studies of Pynte, Ferric and High-Spin ferrous Distribution in Sulfide-Rich Sediments from Moira Lake, Ontario; Canadian Mineralogist, Vol. 17, No. 1, p. 111-115.

ABSTRACT:

The room-temperature Mossbauer spectra of freeze-dried sulfide-rich sediments from Moira Lake, Ontario, comprise an outer high-spin ferrous doublet and an inner envelope made up mainly of pyrite and ferric doublets. In the upper 16 cm of sediment, iron is distributed between pyrite, ferrous, and ferric forms in the ratios 23:52:25. At greater depths, additional pyrite has formed at the expense of ferric ion, the ratios for the 28-30 cm fraction being 48:27:25. The lower pyrite and total-sulfide concentrations in the upper 30 cm of sediment may reflect higher dissolved-oxygen concentrations in the pore-waters, due to bioturbation processes. Alternatively, increased arsenic contamination in the upper 30 cm may be inhibiting the activity of sulfate-reducing bacteria.

DATA:

Primary Source.

202. MARSALEK, J.
1978: Pollution Due to Urban Runoff: Unit Loads and Abatement Measures; Report, PLUARG, International Joint Commission, Windsor, 37 p.

ABSTRACT:

Annual unit pollutant loads from urban runoff were established and recommended for use in the PLUARG model. The recommended loads are based on both the APWA loads and the selected Ontario Data.

The APWA loads for BOD, nitrogen and phosphorus agreed fairly well with the loads derived from the Ontario data and formed a basis for the recommended loads. The loads recommended for suspended solids and selected metals were derived from the Ontario field data. As is obvious from the range of unit loads reported in the literature, the recommended loads are likely to contain uncertainties as high as several hundred percent.

Three levels of abatement of pollution due to urban runoff were proposed and the associated costs determined.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

203. MARSHALL, E.P.
1979: The Effects of European Landscape Modification on Sedimentation in the Nottawasaga River, Southern Ontario; Unpublished B.Sc. Thesis, Department of Geography, York University, Toronto, 99p.

ABSTRACT:

The Nottawasaga River drainage basin in Southern Ontario covers an area of 1,145 square miles. European colonization of this area began in the early 1820's and by the late 1850's most of the basin was colonized.
This thesis comprises a study of the effect of pioneer forest clearance and agriculture on the floodplain and channel geometry of the Nottawasaga River. This was carried out through the investigation of four bank sections which contained an organic debris layer overlain by recent alluvium.

Subsequent investigation revealed that pioneer clearance of this watershed produced severe erosion of cultivated fields which is revealed in the aggradation of the modern floodplain.

DATA:

Primary Source.

204. MARTINI, I.P.
1973: Mixing of Sediments from Different Sources in the Grand River; Proceeding of the Ninth Canadian Hydrology Symposium on Fluvial Processes and Sedimentation, University of Alberta, Edmonton, May 8-9, p.29-37.

ABSTRACT:

Fluviatile deposits found in the geological column were formed by aggrading rivers and may not reflect variations in textures of

materials observed in graded or slightly aggrading recent channels. Full understanding of sedimentary rocks is hampered by incomplete knowledge of the variability of modern sediments of rivers that cross tectionically active areas or regions covered by recent glacial materials. In the glaciated area of southwest Ontario, the sediments of the Grand River show that the effects of abrasion and differential sorting are well recorded in local environments. They are however obscured within a relative short distance from the point of injection, when eterogeneous sources of materials are available along the river course and mixing of sediments occurs. One such modern source seldom referred to is related to fresh water polecypod shells. They are more numerous and have larger sizes in the lowering reaches of the river. As a result, a downstream coarsening of the bulk samples occurs.

DATA:

Primary Source.

205. MARTINI, I.P.
1977: Gravelly Flood Deposits of Irvine Creek, Ontario, Canada; Sedimentology, Vol. 24, No. 5, p. 603-622.

ABSTRACT:

In May 1974 a powerful flood flushed the Grand River basin, Ontario. The effects on the bedload were drastic in a narrow (30 m) and deep (40 m) rock walled and floored gorge near Elora, Ontario. Along Irvine Creek, the tributary occupying the gorge, the gravel cover was reworked in several types of bars, predominantly transverse and point bars. The bars formed very rapidly in response to essentially steady, non-uniform flow that developed during a brief period of high flood.

Superimposed on major bars are several minor sedimentary features such as coarse transverse ribs, chute channels and bars, longitudinal ribs, imbrication clusters, backsets with well developed imbrication, that were formed under very high stream discharge. Structures like imbrication clusters, transverse ribs and small riffle bars require a 'live bed' situation to form, and they develop when stones come to a stop either because they cluster during transport, or because keystone effects occur along shallow channels. In Irvine Creek, very few sedimentary features were formed during waning and low flood stages: only some shadow deposits and a few Ostler lenses. The few fines that were available were lost downstream or filled in lower parts of gravel beds.

This study confirms that in streams that experience strong seasonal fluctuations in discharge, bedforms that develop during high floods have a high probability of preservation. In gravelly deposits, foreset structures and plane beds are most commonly

preserved, although they may be difficult to recognize in old deposits, which may appear massive, particularly if the gravel has been infilled with finer pebbles and sand. In the case of Irvine Creek, all deposits are organized, and lateral and vertical variations in textures, particularly imbrication and packing, are very useful in the recognition of sedimentary structures.

DATA:

Primary Source.

206. MAYER, T.
1984: Phosphorus Mobility in Sediments Upon Lake Acidification; Unpublished M.Sc. Thesis, Department of Geology, McMaster University, Hamilton, 136p. (Also unpublished N.W.R.I. report no. 84-44.)

ABSTRACT:

The forms of phosphorus in sediments of acid and non-acid shield lakes were determined in order to assess the effects of lake acidification on the mobility of sediment phosphorus. Sediment phosphorus is conveniently classified into three categories: non-apatite inorganic phosphorus (NAI-P). apatite-P and organic P. The distribution of P between different categories was found to be dependent on the lithology of the lake basin, the pH in the water column, and the redox conditions.

More than 90% of inorganic P in shield lake sediments was in the NAI-P category, associated presumably with hydrated Fe and Al oxides. Organic P accounted for more than 40% of total P in sediments of acid lakes, which is proportionally higher than that found in sediments of neutral lakes. Bioavailable P, a measure of the fraction of sediment inorganic P readily available for biological utilization, amounted to -70% of NAI-P, similar to that found in hard water lakes.

A series of experiments was designed to investigate the immobilization of P from solution. The uptake of P by solid phase was explained by an adsorption mechanism. The quantitative estimates of phosphates sorption parameters for sediments of acid and non-acid lakes show that mineralogical and chemical characteristics of sediments are more important than the pH of water in determining their efficiency of P removal. Therefore, acidification of lakes does not significantly influence the uptake of P by sediments.

DATA:

Primary Source.

207. MAYER, T. and KRAMER, J.R.
1985: Effect of Lake Acidification on the Adsorption of Phosphorus by Sediment; Unpublished National Water Research Institute report, NWRI Contribution No. 85-104, 11p.

ABSTRACT:

The retention properties of acidic and non-acidic lake sediments were determined in order to assess the effects of lake acidification on the immobilization of P from solution by sediments. The adsorption of P by solids was described by the Langmuir model which was used to determine the sorption parameters, e.g. sorption maxima and equilibrium constant of adsorption. The pH of solution and the chemical and mineralogical characteristics of sediments affect mainly the magnitude of adsorption maxima. The binding strength of the adsorbed complex is similar for all the investigated sediments ($\Delta G$-25.3 to -28.5 kJ $mol^{-1}$) and it is affected little by variation in pH or by chemical and mineralogical composition of sediments. The results indicate that the magnitude of P removal is determined more by sediment chemistry and mineralogy (amorphous Al/Fe oxy-hydroxides, carbonate content) than by pH of the water.

DATA:

Primary Source.

208. MAYER, T. and WILLIAMS, J.D.H.
1981: Modified Procedures for Determining the Forms of Phosphorus in Freshwater Sediments; Environment Canada, Inland Waters Directorate, National Water Research Institute, Technical Bulletin No. 119, 9p.

ABSTRACT:

An analytical procedure for the determination of various forms of phosphorus in sediments is described. The method has been widely used on a variety of samples such as lacustrine and fluvial sediments, bluff material and some pure phosphorus minerals. It is suitable for the analysis of a large number of samples, because it is possible to carry out extraction in batches and the determinations on the extracts can easily be automated.

DATA:

Primary Source.

209. McCORQUODALE, J.A., IBRAHIM, K. and HAMDY, Y.
1986: Fate and Transport Modelling of Perchloroethylene in the St Clair River; Water Pollution, Research Journal of Canada, Vol. 21, No. 3, p. 398-410.

ABSTRACT:

The responses of the St. Clair River system (water column and bed sediments) to a spill of perchloroethylene (PERC) is predicted by application of the U.S. Environmental Protection Agency (EPA) TOXIWASP fate transport model. The spill occurred from August 13 to 16, 1986 at the Dow Chemical of Canada Inc. site. The estimated quantity of the spill was 18000 kg of which approximately 10,000 kg initially settled out in the vicinity of the Dow Chemical outfalls. At the end of 30 days the model indicated that about 12600 kg had been discharged to Lake St. Clair while 4500 kg and 90 kg remained on the river bed and in temporary storage in the water column respectively. Approximately 5% of the original spill was volatilized in the river during the 30 days after the spill.

DATA:

Secondary Source; refer to Environment Canada and Ontario Ministry of the Environment (1985).

210. McCREA, R.C. and FISCHER, J.D.
1986: Heavy Metal and Organochlorine Contaminants in the Five Major Ontario Rivers of the Hudson Bay Lowland; Water Pollution Research Journal of Canada, Vol. 21, No. 2, p.225-234.

ABSTRACT:

Water, bottom sediment and two species of fish collected upstream of the mouths of the Moose, Albany, Attawapiskat, Winisk and Severn Rivers were analyzed for heavy metals and a wide range of organic contaminants. Iron and aluminum were present in raw water samples with mean concentrations ranging from 260 to 860 ug/L and 60 to 470 ug/L respectively. Polychlorinated biphenyls (PCBs), α-BHC, γ-BHC, cis-chlordane, trans-chlordane, p,p$^{1}$-DDE, dieldrin and HCB were also found in water at levels comparable to an industrialized region of Ontario. Organochlorine pesticides, chlorobenzenes, polyaromatic hydrocarbons and phthalates were not detected in bottom sediments, however, trace amounts of PCBs were found in Moose and Severn River sediments. Trace concentrations of a few organochlorine contaminants were detected in both fish species. The solubilization, absorption and bioaccumulation of many of the contaminants were thought to have been affected by the presence of naturally occurring organic acids.

DATA:

Primary Source.

211. McCREA, R.C., KWIATKOWSKI, R.E., CAMPBELL, K.E., McCARTHY, P.P. and NORRIS, T.A. 1984: An Investigation of Contaminants and Benthic Communities in the Major Rivers of the Hudson Bay Lowland, Ontario; Environment Canada, Inland Waters Directorate, Water Quality Branch, Ontario Region, Technical Bulletin No. 131, 47p.

ABSTRACT:

A comprehensive water quality study was conducted June 4-11, 1981, near the mouths of the five major rivers of the Hudson Bay Lowland. A wide range of trace organic and trace metal contaminants were measured in water, fish, suspended and bottom sediments. Although levels of organochlorine pesticides were generally low in the water samples, a wide range of compounds were detected. Total PCB's (polychlorinated biphenyls), α-BHC and p,p$^{1}$-DDE were most often detected in fish and the concentrations of all of the compounds present were very low. Polychlorinated biphenyls were the only compounds detected in suspended sediment samples and all trace organic contaminants were below the detection limit in bottom sediment. The results of the survey conducted to determine benthic structure indicate that a large number of benthic species were present in each river, but that no one species predominated. The Chironomidae and Tubificidae families were the two major taxonomic groups in terms of numbers of individuals in each river.

DATA:

Primary Source.

212. McLEAN, W.A. 1981: Impact of Erosion/Sedimentation on Recreation Potential; In: Erosion and Sedimentation in Ontario. A Time for Action, Some Papers from the Winter, Summer and Fall Meetings of the Ontario Chapter, Soil Conservation Society of America, Erosion and Sedimentation, a Fresh Look at the Problem in Ontario, February 11, 1977, Canada Centre For Inland Waters, Burlington, p. 12-17.

ABSTRACT:

Southern Ontario has two types of landscapes, those that are in the process of being created by erosion and those that have been created by sedimentation. In some areas these processes are continuing at a rapid pace and their time. In some areas which were formerly in a state of relative stability, the process of urban development has accelerated the process of erosion and sedimentation. It is thought that there is a correlation between those areas which are subject to most active erosion and their consequent unsuitability for most of man's uses and an attractiveness for recreation. The headwaters of many streams in Southern Ontario is the Oak Ridges interlobate moraine, a land form subject to severe erosion. A unique feature of the moraine

is the presence of a large number of kettle lakes. The Niagara escarpment, the Lake Ontario shoreline, the lower great lakes shorelines and the Scarborough Bluffs are parts of the Ontario landscape wher the processes of erosion and sedimentation are evident. It appears that lands which are very difficult to develop or use because of flooding, erosion and sedimentation are the most attractive and sought-after recreational sites. Heart lake, a kettle lake near Brampton, was developed as a multi-purpose conservation area. The pressure of recreation use of this land and lake has accelerated erosion on the steeply sloping banks, leading down to the lake and the shoreline of the lake. The attractiveness of the area was reduced and corrective measures taken, the most expensive of which was the stabilizing of the shoreline which had been badly eroded. Extensive sections of lower river valleys have been acquired as flood plain and conservation lands and have been developed for recreational use, necessitating a substantial investment of make the lands suitable, and for protective work. In some cases where upstream reservoirs have been constructed to cope with floods, water depth may be reduced, thus reducing the use of the estuary for boating purposes. The use of the Great lakes shoreline for recreation purposes involves management and protective works. Estuaries of rivers are used for boating which leads to silting of the river mouth, accretion of sandbars and flooding, hence requiring dredging. In rapidly eroding sections of the shoreline landfills are constructed to protect the toe of the slopes. The activities of man effect the ratio of erosion and sedimentation. Land used adjacent to the eroding areas on upland slopes, river valleys, river mouths and the shoreline also have an effect on rates. The development of storm water management for urban areas could have a dramatic effect on reducing the impact of erosion and sedimentation on the recreational use of hazard areas.

DATA:

Secondary Source.

213. McNEELY, R.N.
1973: Limnological Investigations of a Small Meromictic Lake, Little Round Lake, Ontario, 1968-1970; Unpublished Ph.D. Thesis, Department of Biology, Queen's University, Kingston, 239p.

ABSTRACT:

Limnological investigations were initially undertaken on Little Round Lake to ascertain the limnological variables that may be of primary importance in the palaeoecological interpretation of Little Round Lake's sedimentological history. Various sedimentological parameters have been analysed from Little Round Lake, but very little published data are available on the limnological parameters. Preliminary investigations of Little Round Lake indicated that the lake exhibited a number of interesting phenomena: clinograde oxygen profile with anoxic bottom water; and apparent low organic production even though the sediment is a rich organic gyttja.

Little Round Lake was sampled at a central station (16.8 m depth) every two weeks for two years (May, 1968 - May, 1970). Initially only the basic limnological parameters were measured, but gradually the study was expanded to include the major anions and cations, inorganic and organic carbon and sulfur compounds and nutrient (N and P), as well as temperature, dissolved oxygen, conductivity and pH. The temperature was measured with a YSI tele-thermometer; conductivity with a Beckman conductivity meter; dissolved oxygen with an EIL dissolved oxygen meter; pH with a Metrohm pH meter and combination electrode; and turbidity with a Hach turbidity meter. Inorganic carbon and sulfur compounds were measured on unfrozen samples: 'free' carbon dioxide, alkalinity and sulfide by titration; and sulfate by nephelometry with barium chloride. All other analyses were done on quick-frozen samples stored at -20° C until analysed. Calcium, magnesium, sodium and potassium were analysed by atomic absorption spectroscopy. Total organic carbon was measured on a Beckman Carbonaceous Analyser. The nitrogen and phosphorus compounds, as well as silica and total iron, were measured by automated techniques on Technicon Auto Analyzers.

Little Round Lake is a calcareous, slightly humic, first class dimictic lake with an annual heat budget of 13,697 $cal.cm^{-2}$. Little Round Lake exhibits biogenic meromixis of low stability (83 $g\text{-}cm.cm^{-2}$). The meromixis is maintained by a combination of favourable environmental and morphometric characteristics which restrict mixolimnetic circulation to 10 m depth. Cultural enhancement of the lake's meromixis has occurred in recent years. Purple photosynthetic sulfur bacteria actively grow in the chemocline region during the ice-free months. A low rate of oxygen depletion during four and a half months of ice-cover (28.8 $mg.m^{-3}).dy^{-1}$) and low nutrient concentrations suggest that Little Round Lake is presently oligotrophic, but prior to the inception of meromixis the lake was probably mesotrophic or even meso-eutrophic as suggested by holomictic nutrient calculations. Nutrient budgets were not measured in Little Round Lake, ubt nutrient cycling and transformation were evident.

DATA:

Primary Source.

214. MILES, J.R.W.
1976: Anthropogenic Influences of Sediment Quality at a Source. Pesticides and PCB's; Proceedings of the Workshop on the Fluvial Transport of Sediment-Associated Nutrients and Contaminants, H. Shear and A.E.P. Watson, Editors, October 20-22, 1976, Kitchener, p. 69-71.

ABSTRACT:

The author discusses the concentration of insecticides found in soil and on the various sediments, the conversion of DDT to its

metabolites on sediments, and the relation of water solubility to insecticide adsorption onto sediments. Big Creek in Norfolk County, Ontario and the water system draining the 7,500 acre Holland Marsh, 30 miles north of Toronto were studied. Significantly different insecticide residue concentrations were found in soil, suspended sediment, bed load and bed material.

DATA:

Primary Source.

215. MILES, J. R.W.
1977: Insecticide Residues on Stream Sediments in Ontario, Canada; Pesticides Monitoring Journal, Vol. 10, No. 3, p. 87-91.

ABSTRACT:

Insecticide residues on suspended and bottom sediments of streams of Ontario, Canada, have been studied in a tobacco-growing and a vegetable muck area. The proportion of TDE to DDT was <1 in water and >1 in bottom sediments. The ratio of TDE to DDT in bottom material increased linearly from the contamination point as stream source to the mouth of Big Creek in Norfolk County, Ontario. Bed load samples contained three to six times greater concentrations of insecticides than bottom material. Adsorption of insecticides on suspended sediment decreased in order DDT > TDE > dieldrin > diazinon, which is consistent with the water solubility of these compounds.

DATA:

Primary Source.

216. MILES, J.R.W. and HARRIS, C.R.
1971: Insecticide Residues in a Stream and a Controlled Drainage System in Agricultural Areas of Southwestern Ontario, 1970; Pesticides Monitoring Journal, Vol. 5, No. 3, p. 289-294.

ABSTRACT:

A creek flowing into Lake Erie and a controlled drainage system (the water of which is pumped into Lake Erie) were monitored for insecticide residues during 1970. Big Creek, located in Norfolk County, Ontario, drains an area of 280 square miles, chiefly tobacco farms. P,p'-DDE, o,p'-DDT, p,p'-DDD, p,p'-DDT, and dieldrin were determined in water, bottom mud, and fish. The greatest concentration of total DDT was 67 parts per $10^{12}$ (American trillion) in the water, 441 pp $10^{9}$ (American billion) in the mud, and 1.0 ppm in the fish. There appeared to be a correlation between rainfall and the concentration of insecticide in the creek water. In 1970, the total amount of organochlorine

insecticides that passed from this creek into Lake Erie per week averaged 0.11 lb. The drainage system, near Erieau, Ontario, drained about 1,500 acres of muck land used for growing vegetables. Concentrations of insecticides in the drainage system were greater than those in Big Creek, but the transfer of insecticides into Lake Erie was much less from the drainage system.

DATA:

Primary Source.

217. MILES, J.R.W. and HARRIS, C.R.
1973: Pesticides in Water; Pesticides Monitoring Journal, Vol. 6, No. 4, p. 363-368.

ABSTRACT:

Organochlorine insecticide residues in water sytems draining agricultural, urban-agricultural, and resort areas of Ontario, Canada, were compared by analysis of water, bottom mud, and fish, collected during the period from mid-April to mid-October 1971. Insecticides detected were p,p'-DDT, o,p'-DDT, p,p'-TDE, o,p'-TDE, p,p'-DDE, y-chlordane, dieldrin, endrin, endosulfan, heptachlor, heptachlor epoxide, lindane, and aldrin. Insecticide concentrations in water from all three areas were less than the "Maximum Reasonable Stream Allowances" for growing fish that are safe for human consumption.

The concentrations of total DDT in the water were combined with water flow data to calculate the weekly rate of transport of total DDT at each sampling time. The greatest transport of total DDT was by the Muskoka River which drains the Muskoka Lakes resort area where DDT was used until 1966 for control of biting flies; a peak of 11.8 lb total DDT per week. Corresponding figures for the Thames River (urban-agricultural) were peak 2.5 lb and average 0.4 lb total DDT per week and for Big Creek (agricultural), peak 0.5 lb and average 0.2 lb per week.

The ratio of concentration of total DDT in mud to total DDT in water was as great as 800; total DDT in fish to total DDT in water was as great as 1 million. The ratio of p,p'-TDE to p,p'-DDT was <1 in water bu >1 in bottom mud, indicating possible dechlorination of p,p'-DDT to p,p'-TDE in the bottom mud. Polychlorinated iphenyls (PCD's) were present in the urban-agricultural area samples of bottom mud and fish at levels up to 217 ppm and about 0.4 ppm, respectively.

DATA:

Primary Source.

218. MILLARD, E.S., CHARLTON, C.C. and BURNISON, G.A.
1979: Availability of Phosphorus in Different Sources Entering the Great Lakes for Algal Growth; Report, Task Group D Canadian Section, PLUARG, International Joint Commission, Burlington, 38 p.

ABSTRACT:

The bioavailability of phosphorus in various sources contributing to loadings of this element in the Great Lakes was studied in lake column simulators. Loading of total phosphorus was equivalent between treatments that included river water, tertiary-treated sewage effluent, shoreline bluff material and Grand River suspended particulates. Growth response of algal communities to treatments was compared with the response to phosphoric acid. A background response due to phosphorus in the water which was used to fill the columns, and contaminating sources was also measured. Averages for total and soluble reactive phosphorus concentrations were similar between treatments, although obvious differences in growth response were observed. Sewage effluent produced an overall growth response equivalent to the phosphoric acid control, while river water had an overall response of 65% of the control. Response to bluff material was indistinguishable from that due to background sources. An inverse relationship existed between nitrate concentrations and phosphorus availability. The full response to the Grand River particulates and its control was probably limited by zooplankton grazing pressure. All other columns had declines in algal standing crops coincident with increases in numbers of Bosmina spp.

In bluff material, the high density of particles containing apatite phosphorus and the poor solubility of this compound led to a short residence time in the upper layer and low bioavailability of the phosphorus in this treatment. The impact of shoreline erosion on the Great Lakes in terms of phosphorus loading is negligible compared with municipal point-source and diffuse tributary loads to phosphorus. The cost-effectiveness of phosphorus control strategies proposed by PLUARG is increased in a relative sense when bioavailability of phosphorus is considered.

DATA:

Primary Source; also refer to Ontario Ministry of the Environment data.

219. MILLER, D.R.
1977: Distribution and Transport of Pollutants in Flowing Water Ecosystems; Final Report, Ottawa River Project, National Research Council of Canada, 2 volumes.

ABSTRACT:

This report describes activities of the Ottawa River Project a joint study by the University of Ottawa and the National Research

Council of Canada, which was carried out between the summer of 1972 and March 1977.

DATA:

Primary Source.

NOTE: Interim reports appeared in 1972, 1974, 1976 under the title "Distribution and transport of Pollutants in Flowing Water Ecosystems".

220. MILLER, D.R.
1977: Generation of Methylmercury in River Sediments; In: Distribution and Transport of Pollutants in Flowing Water Ecosystems, D.R. Miller, editor, Final Report of the Ottawa River Project, p. 19.1 - 19.24.

ABSTRACT:

There now seems to be a considerable weight of evidence that methylation should not be thought of as a detoxification mechanism of a large part of the microbial population. This conclusion is quite consistent with arguments presented sometime ago, e.g., by Landner (1971), to the effect that it was surprising that a detoxification mechanism would routinely produce a much more highly toxic compound. It now appears that production of methylmercury is not a dominant process at all; rather, that the fraction of methylmercury present in the sediment at any time is small (except for very specialized sediment types) and more or less constant. Furthermore, the partition of methylmercury between water and sediment appears constant, whether methylmercury is being removed from the water or not. What is necessary, we suggest, is not detailed studies of biological mechanisms of methylmercury production, but rather dynamics of methylmercury production and transport in the sediment water food fish system. It appears that the emphasis may profitably shift, as has been advocated by others (Krenkel, 1973), away from microbial metabolism in the direction of the study of real, or at least environmentally representative, sediment systems.

DATA:

Primary Source.

221. MILLER, M.H.
1976: Anthropogenic Influences of Sediment Quality at a Source. Nutrients: Carbon, Nitrogen and Phosphorus; Proceeding of the Workshop on the Fluvial Transport of Sediment-Associated Nutrients and contaminants, H. Shear and A.E.P. Watson, Editors, October 20-22, 1976, Kitchener, p. 81-93.

ABSTRACT:

The author discusses the influence of crop production on the erosion of farm fields and on the nutrient concentration of the sediment. Alterations in carbon, nitrogen and phosphorus content of surface soils are discussed.

DATA:

Primary Source.

222. MILLER, M.H. and SPIRES, A.C.
1978: Contribution of Phosphorus to the Great Lakes from Agricultural Land in the Canadian Great Lakes Basin; Report, Task Group C (Canadian Section), Activity 1, PLUARG, International Joint Commission, 55 p.

ABSTRACT:

The contributions of phosphorus to the Great lakes from agricultural land and the associated activities in southern Ontario have been estimated primarily from the information obtained from the monitoring data and the several detailed studies conducted in the representative agricultural watersheds. Because there is very limited agricultural activity in the northern Ontario portion of the Canadian Great Lakes Basin, the estimates made are thought to be valid for the total Canadian Great Lakes Basin.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

223. MORRIS, J.R.
1982: Benthological Studies in the Turkey Lakes (Algoma); Turkey Lakes Watershed Unpublished Report No. TLW-82-06, 21 p.

SUMMARY:

This paper present results and a discussion of studies on lake sediment cores from the Turkey Lakes Watershed. Data includes profiles of pH, Cu, Ni, Pb, Zn, Al, Mn and Ca. The distribution and abundance patterns of benthic invertebrates is also assessed.

DATA:

Primary Source.

224. MORTIMER, D.C, and KUDO, A.
1974: Interaction Between Aquatic Plants and River Bed Sediments in the Uptake of Mercury from Flowing Water; Proceedings of the International Conference on Transport of Persistent Chemicals in Aquatic Ecosystems, Ottawa, May 1-3, 1974, p. III 11 - III 15, (Also Journal of Environmental Quality, vol. 4, No. 4, 1975, p. 491-495).

ABSTRACT:

Bed sediment from a known zone in the Ottawa River study area and fronds of Elodea densa were set out in aquaria in a 24 day controlled, flowing water experiment. Fronds were planted in sediment and in glass beads, and sediment was exposed with and without plants, all in the same aquaria for 7 days before the addition of mercury and traced by 203 Hg. Three concentrations of each of mercuric chloride and methyl mercuric chloride were continuously metered into the input water to yield aquarium levels of 0.2, 2, and 10 ug/l.

There is no significant difference in the uptake rate between the two forms of mercury. Uptake is proportional to water concentration over the entire 17 day exposure period in both plants and seidment. Methyl mercury is more toxic to plant growth in this time interval than inorganic mercury. Elodea growing in sediment absorbs significantly less mercury than Elodea growing in glass beads. Sediment from which the plants have been removed contains about twice as much mercury as plantfree sediment. The aquarium walls are the largest absorbing compartment in the system and methyl mercury is absorbed more strongly than inorganic mercury. The total recovery of input mercury over the 17 days averages 91%.

DATA:

Primary Source.

225. MORTIMER, D.C. and KUDO, A.
1977: Interactions Between Aquatic Plants and Sediments, Invertebrates and fish with Respect to transport and Accumulation of Mercury; In: Distributions and Transport of Pollutants in Flowing Water Ecosystems, D.R. Miller, editor, Final Report of the Ottawa River Project, p. 23.1-23.22.

ABSTRACT:

This chapter examines several approaches to studying the interactions between the higher aquatic plants and components of the system, that include: sediments, invertebrates and fish with respect to the redistrubtion and transport of mercury. No correlation is found between mercury in the sediment and mercury absorption by the plants nor is there any indication that aquatic

roots mediate the liberation of mercury from sediments. Invertebrates isolated from river aquatic plants contained 10 to 100 times more mercury than comparable invertebrates isolated from the sediments near the plants. The radiocarbon data demonstrates that about 60 percent of anabena carbon and 25 percent of spirogyra carbon are assimilated by the brown bullhead within 24 hours of ingesting the capsule containing the algae.

DATA:

Primary Source.

226. MUDROCH, A.
1974: The Feasibility of Using Dredged Bottom Sediments as an Agricultural Soil; Unpublished M.Sc. Thesis, Department of Geology, McMaster University, 79 p.

ABSTRACT:

The utilization of contaminated bottom sediments as agricultural soil was investigated as a new approach of the dredged sediment disposal.

Bottom sediments collected from Hamilton Harbour, Humber Bay, Port Stanley, Detroit River Mouth, and Lake St. Clair were used for the determination of chemical, physical an biological properties considered important for the evaluation of bottom sediments as agricultural soil.

It was proved in leaching experiments and lysimeters that the concentrations of elements, released from the bottom sediments dispersed in water, were lower than those recommended for water for public use with the exception of managanese and nickel. (Cd < 0.001 mg/l, Cr < 0.2 mg/l, Cu 0.08 mg/l, Fe 0.08 mg/l, Pb < 0.001 mg/l, Mn 2.9 mg/l, Hg < 0.05 mg/l, Ni 0.07 mg/l, Zn 1.1 mg/l). The suitability of contaminated bottom sediments from Hamilton Harbour, Humber Bay and Detroit River as agricultural soil was verified in greenhouse experiment by planting tomatoes and corn with a good crop yield. The crop yield of the Humber Bay tomato plants was best, followed by those of Hamilton Harbour and Detroit River.

Tomato plants and corn did not take up various elements in the proportions in which the elements occurred in the sediments, but exerted a selective action, absorbing greater amounts of some elements than others. Tomato plants took up nutrients and trace elements only to a certain limiting concentration characteristic for individual plant organs. The concentrations were comparable with those found by soil scientists studying the uptake of elements from soils.

Following maximum concentrations were determined for tomato fruit grown in Humber Bay sediment: K 37,000 mg/kg, Mg 2,100 mg/kg, Ca 1, 750 mg/kg, Zn 40 mg/kg, Sr 30 mg/kg, Cu 23 mg/kg, Pb 12 mg/kg, Co 7 mg/kg, Cd 2 mg/kg - Arsenic, molybdenum, manganease, chromium, nickel and mercury were below the levels of detection.

DATA:

Primary Source.

227. MUDROCH, A.
1980: Biogeochemistry Investigation of Big Creek Marsh, Lake Erie, Ontario; Journal of Great Lakes Research, Vol. 6, No. 4, p. 338-397.

ABSTRACT:

Geochemical composition of sediment, uptake of nutrients and metals by macrophytes, and nutrients and metal concentration in the water was investigated at six selected stations in Big Creek Marsh, Ontario. The maximum concentrations of Pb, Ni, Cu, Cr, and Zn in marsh sediment (86, 48, 38, 119, and 383 µg/g dry weight, respectively), were lower than the concentration of these metals found in fine-grained surficial sediments of Lake Erie, and maximum concentration of As and Hg in marsh sediment (112 and 0.930 µg/g dry weight, respectively) were higher than As and Hg concentration in most of Lake Erie surficial sediments. Occurrence of DDT metabolites in marsh sediment reflects extensive use of DDT in the Big Creek drainage basin prior to 1970. Increase of total Kjeldahl Nitrogen and $NH_4$-N marshwater was observed at a few sampling stations in November. Submerged macrophytes Myriophyllum, Chara, and Elodea sps. accumulated larger quantities of Pb, Cu, Ni, Cd, and Cr than emergent macrophytes at the stage of maximum development. Correlation between Ca and Pb, Cu, Ni, and Cr concentration in sampled macrophytes was observed; however, there was no correlation between Ca and Zn in these plants.

DATA:

Primary Source.

228. MUDROCH, A.
1985: Geochemistry of the Detroit River Sediments; Journal of Great Lakes Journal, Vol. 11, No. 3, p. 193-200.

ABSTRACT:

The objectives of the investigation were to provide information on the concentration and distribution of metals in bottom sediments of the Detroit River and to study the association of metals with

various sediment components. Concentrations of major elements (Si, Al, Ca, Mg, Na, K, Fe, Mn, and P) and metals (Co, Cr, Cu, Ni, Pb, and Zn), particle size distribution, and mineralogical composition were determined in 20 surficial sediment samples collected along the Detroit River in 1983. Significantly higher concentrations of metals in the Detroit River sediments than those reported in Lake St. Clair and Lake Erie sediments indicated input from sources in the river's drainage basin. Poor relationships exist between the metals and organic C and the metals and the silt-clay size fraction (<63 µm). The association of metals with sediment particles was investigated by a separation of sediment into seven size fractions ranging from <13 to >63 µm. Zn, Ni, Cr, and Pb were accumulated in <13µm size fraction. However, Cu and Cr concentrations were highest in the <13 and 48 to 63 µm fractions. Quartz, feldspars, and calcite were found in the >63 µm fraction. Dolomite, feldspars, and quartz were in the 13 to 63 µm fraction and clay minerals illite, chlorite, and kaolinite were in the <13 µm fraction. Concentrations and relationships among major elements reflected the mineralogical composition of different particle size fractions.

DATA:

Primary Source.

229. MUDROCH, A. and CAPOBIANCO, J.A.
1979: Effects of Mine Effluent on Uptake of Co, Ni, Cu, As, Zn, Cd, Cr and Pb by Aquatic Macrophytes; Hydrobiologia, Vol. 64, No. 3, p. 223-231.

ABSTRACT:

Concentrations of Ni, Co, Cu, Pb, Zn, Cd, Cr and As were determined in aquatic sediments, water and macrophytes collected from a fluvial system, contaminated by mine effluents. Myriophyllum verticillatum collected in May below the trace element point source accumulated 169 µg/g of Ni, 860 µg/g of Co, 37 µg/g of Cu, 31 µg/g of Pb, 92 µg/g of Zn, 6.9 µg/g of Cr and 1,200 µg/g of As (concentrations in dry weight). The aquatic macrophytes Nymphaea odoratae and Pontederia cordata accumulated the investigated trace elements to a much lesser extent. The concentrations of trace elements in Myriophyllum verticillatum decreased from May to August. Correlations were found between the concentrations of total Ni, Co and Cu in the bottom sediment and in the the submerged macrophytes. However, there was no correlation between the amounts of these trace elements extractable by 0.5 N HCl from the sediments and the concentrations in the macrophytes.

DATA:

Primary Source.

230. MUDROCH, A. and CAPOBIANCO, J.A.
1980: Impact of Past Mining Activities on Aquatic Sediments in Moira River Basin, Ontario; Journal of Great Lakes Research, Vol. 6, No. 2, p. 121-128.

ABSTRACT

The geochemistry of aquatic sediments collected from the Moira River system, which empties into eastern Lake Ontario, was studied to determine the distribution and transport of Ni, Co, Cu, Pb, Zn, Cr, Hg, Ag, and As through the system. Surface sediment from 14 stations and sediment from two core profiles collected at Moira Lake Bay of Quinte were analyzed. concentrations of Si, Al, Fe, Mg, K, and Na, which represent the major mineral species were generally similar in all samples. However, significant enrichment of As, Cu, Co, and Ni were observed in the surface of the core from Moira Lake, downstream from previous mining and smelting activities at Deloro where wastes were discharged in Moira River. The horizonal distribution of trace element concentrations in the sediment decreased with increasing distance from the old mining and smelting site. Water samples collected downstream from this area contained 250 µg $L^{-1}$ of As, indicating significant release of As into the watershed at the present time.

DATA:

Primary Source.

231. MUDROCH, A. and DUNCAN, G.A.
1986: Distribution of Metals in Different Size Fractions of Sediment from the Niagara River; Journal of Great Lakes Research, Vol. 12, No. 2, p. 117-126.

ABSTRACT:

This study was carried out to demonstrate that the concentration of major and trace elements, determined in sediment samples separated mechanically into different size fractions, gives better information for assessing a potential hazard of in situ, dredged, or resuspended sediments than the bulk to total concentration. The concentrations of major elements (Si, Al, Ca, Mg, Na, K, Fe, Ti, Mn, and P), trace elements (Cr, Co, Cu, Zn, V, Ni, and Pb), and organic and carbonate C were determined in six size fractions (<13 µm, 13-19 µm, 19-27 µm, 27-40 µm, 40-54 µm, and 54-150 µm) of bottom sediments collected at eight stations along the Niagara River. Fine particles (<13 µm) separated from the river sediments exposed to pollution sources accumulated greater metal quantities than particles in the other size fractions. The contribution of trace elements from specific size fractions was calculated from the particle size distribution and trace elements concentration. With the exception of Ni, significant differences were found between trace elements concentration in specific

particle size fractions of Niagara River sediments and that from the nearshore zone of Lake.

DATA:

Primary Source.

232. MUNAWAR, M., MUDROCH, A., MUNAWAR, I.F. and THOMAS, R.L.
1983: The Impact of Sediment - Associated Contaminants from the Niagara River Mouth on Various Size Assemblages of Phytoplankton; Journal of Great Lakes Research, Vol. 9, No. 2, p. 303-313.

ABSTRACT:

The impact of elutriated sediment-associated contaminants from the Niagara River mouth and from a midlake station in Lake Ontario on various size assemblages of natural phytoplankton was determined. The $C^{14}$ fractionation bioassays indicated that the addition of Chelextreated elutriate (without dissolved metals) from the Niagara River mouth enhanced the $C^{14}$ uptake when compared to the standard elutriate. Conversely, at the midlake station, the addition of standard elutriate (with dissolved metals) induced higher $C^{14}$ uptake than the Chelex-treated elutriate. It is apparent that the synergistic effects of nutrients/metals and metals/organic compounds determine the bioavailability and toxicity of contaminants to natural phytoplankton. Our technique is sensitive and useful in detecting the differential response of algal size fractions to contaminants.

DATA:

Primary Source.

233. MUNAWAR, M., THOMAS, R.L., NORWOOD, W. and MUDROCH, A.
1985: Toxicity of Detroit River Sediment-Bound Contaminants to Ultraplankton; Journal of Great Lakes Research, Vol. 11, No. 3, p. 264-274.

ABSTRACT:

Four sites in the Detroit River/Lake Erie western basin were evalutated for their toxicity. The evaluation was based on 1) bulk chemical characterization of the sediments, 2) chemical composition of the sediment elutriates, and 3) toxicity of the elutriates to ultraplankton and microplankton/net plankton. A sequence of decreasing contamination was determined from the chemical composition of the elutriates based on the elutriation release of metals such as Zn, Mn, Cd, Ni, and Co. Bioassessment of elutriate toxicity was determined by carbon-14 Algal Fractionation Bioassays (AFB's) which were conducted with various dilutions of standard and Chelex-100 treated elutriates. Site A (near Windsor,

Ontario) and Site D (western Lake Erie) were found to be toxic to ultraplankton. The observed to toxicity was attributed to the bioavailability and synergistic impact of elutriated metals on ultraplankton production. A direct relationship between the water soluble metal fraction and toxicity was observed. These results confirmed that sediment toxicity should not be evaluated solely on bulk chemical composition of the sediments. The AFB's have been proven useful in the bioassessment of sediments due to their rapidity/sensitivity and hence could be routinely used for the screening and early detection of contaminants affecting fast growing organisms which form the basis of the aquatic food chain.

DATA:

Primary Source.

234. MUNAWAR, M., THOMAS, R.L., SHEAR, H., McKEE, P. and MUDROCH, A. 1984: An Overview of Sediment-Associated Contaminants and their Bioassessment; Canadian Technical Report of Fisheries and Aquatic Sciences No. 1253, 136 p.

ABSTRACT:

An overview of the published material concerning sediment contamination by trace metals and persistent organics is presented. Information from the Great Lakes is highlighted. Physico-chemical processes governing the behaviour of contaminants in sediments are discussed. The impact of sediment contamination on aquatic biota as well as effect of biota on contaminants are considered. Approaches and procedures used to determine the bioavailability and bioassessment of sediment-associated contaminants are outlined.

DATA:

Secondary Source.

235. MUNRO, J.R., FOSTER, M.G., PAWSON, T., STELZIG, A., TSENG, T. and KING, L. 1985: St. Clair River Point Source Survey 1979-1980; Joint Report, Ontario Ministry of the Environment and Environment Canada, 194 p.

ABSTRACT:

A total of 235 samples were collected from industrial discharges, process sewers and service waters in the St. Clair River area over a two-year period and analyzed for 78 selected organic priority pollutants. Of these 78 organic priority pollutants, 74 were identified at least once during the study. The most frequently found compounds in final discharges were:

Benzene
Cis-1, 3-dichloropropene
2-Chloroethylvinylether
1,1,2,2,-Tetrachloroethane
Tetrachloroethylene
Bis(2-ethylhexyl) phthalate

These compounds were indentified in more than 50% if the final discharges.

During 1980, four discharges were sampled continuously over extended periods of time. Very few compounds were consistently identified in any one discharge and the concentration levels of priority pollutants varied up to three orders of magnitude.

In order to evaluate whether a conventional treatment facility could reduce or remove hazardous organic pollutants, the Petrosar wastewater treatment system was continuously sampled for 9 days.

The treatment system did reduce the concentration of many compounds. Each component of the treatment system was effective in reducing different classes of organic compounds.

DATA:

Primary Source.

236. MYSLIK, R.J. and SMITH, B.D.
1980: General Field Procedures for the Collection of Individual Suspended Sediment Samples; Internal Report, Environment Canada, Inland Waters Directorate, Water Survey of Canada, Water Resources Branch, Ontario Region, 16 p.

ABSTRACT:

The intent of these instructions are to provide step-by-step field procedures to be followed when collecting individual suspended sediment samples at a single vertical.

DATA:

Primary Source.

237. NAGY, E., CAREY, J.H., and HART, J.H.
1986: Hydrocarbons in St. Clair River Sediments; Water Pollution Research Journal of Canada, Vol. 21, No. 3, p. 390-397.

ABSTRACT:

A survey of St. Clair River sediments at Sarnia, Ontario, showed that the highest concentrations of normal alkanes and polyaromatic

hydrocarbons occurred in the vicinity of the petrochemical industrial area on the Canadian side of the river. The absence of an odd-carbon predominance in the alkanes, and the presence of several alkylated polyaromatics indicate a petroleum source of both classes of hydrocarbons. Both classes of compounds were present, at increased concentrations, in the lower sections of two shallow cores. The distribution of organics reflected the highly localized character of inputs, currents, and sediments.

DATA:

Primary Source.

238. NICOLSON, J.A.
1977: Forested Watershed Studies; Summary Technical Report, Task Group C, Activity 2, PLUARG, International Joint Commission, Windsor, 23 p.

ABSTRACT:

This report presents the results of a study to determine the impact of current forestry practices upon the water, soil and vegetation of the boreal forest ecosystems of Ontario and to develop economically and ecologically acceptable alternative practices where the impact is shown to be detrimental to any of these factors. The study site was the experimental lakes area maintained by Environment Canada's Fisheries and Marine Service, about 55 km southeast of Kenora, Ontario. Clearcutting and/or scarification are the two forest management practices investigated. Water samples were collected and analyzed for forms of nitrogen and phosphorus are the main parameters affected by the harvesting aspects of forestry and were investigated. Results interpretation and conclusions are presented on land uses and practices, unit area loadings, point: non-point distribution, significance of land uses and practices, delivery ratio, physical characteristics of land, soils, and transferability. Recommendations are given on ways to minimize impacts during silvicultural operations, importance of planning in the initial selection, construction and maintenance of intensive recreation areas, ways to minimize effects of pesticides on water quality, and road construction on logging operations.

DATA:

Primary Source; also refer to Environment Canada data.

239. NIELSEN, G.H.
1977: Soluble and Sediment Nutrients Lost from Agricultural Watersheds; Unpublished Ph.D. Thesis, Department of Renewable Resources, McGill University, Montreal, 112 p.

ABSTRACT:

Seven agricultural watersheds in southwestern Quebec and southeastern Ontario, ranging in area from 2,000 to 20,000 hectares, were monitored during 1973-75 for soluble inorganic nitrogen, total soluble phosphorus, calcium, magnesium, potassium, sulfate-sulfur, chemical oxidation demand, discharge, suspended sediment Kjeldahl nitrogen, Bray extractable phosphorus, and ammonium acetate extractable calcium, magnesium and potassium.

For 1974-75 losses in solution and on sediment were calculated for each nutrient. Solution losses were generally <5.0 kg/ha for N, <1.0 kg/ha for P but greater other parts for Ca, Mg and K. About 40% of total watershed N and P but <5% of cations were lost with sediment. Sprint runoff contained a high proportion of annual losses for all monitored nutrients.

Correlations of nutrient loss with land use and soil suggested high nutrient losses from corn and small grain cropping on hydrologic class C soils.

DATA:

Primary Source.

240. NIELSEN, G.H. and MACKENZIE, A.F.
1977: Soluble and Sediment Nitrogen Losses as Related to Land Use and Type of Soil in Eastern Canada; Journal of Environmental Quality, Vol. 6, No. 3, p. 318-321.

ABSTRACT:

In order to assess the amounts and types of nitrogen lost in agricultural drainage, seven agricultural watersheds, with a range of land use patterns and types of soil in southwestern Quebec and southeastern Ontario, were selected, and measurements of discharge rates, soluble inorganic nitrogen, and sediment Kjeldahl nitrogen were made during 1974-75. Correlations of these losses with land use and kind of soil were used to identify critical watershed factors affecting nitrogen loss.

Soluble inorganic N concentrations in streams did not exceed 3.5 µg/ml. No watershed lost >5 kg/ha soluble N, except for the watershed with the maximum corn (Zea mays L.) acreage (33%), which lost 22.8 kg N/ha per year. The pronounced significance of spring melt runoff was demonstrated by the movement of from 56 to 100% of annual soluble N from the monitored watersheds during March, April, and May. Sediment was a major transporter of N in this area, moving from 22 to 67% of total watershed N. Watersheds with greater corn acreage and relatively impermeable soils lost more soluble N, while watersheds with more organic soils and greater cultivated area lost more sediment N.

DATA:

Primary Source.

241. NIELSEN, G.H. and MACKENZIE, A.F.
1977: Losses of Soluble and Extractable Sediment Phosphorus from Agriculture Watersheds in Southwestern Quebec and Southeastern Ontario; Canadian Journal Soil Sciences, Vol. 57, No. 4, p. 465-475.

ABSTRACT:

Runoff from seven predominantly agricultural watersheds in southwestern Quebec and southeastern Ontario was monitored from May 1974 to May 1975 for total soluble phosphorus (TSP) Bray 2 extractable phosphorus, sediment and discharge. Although watershed unit area soluble P losses were small, only exceeding 1 kg/ha in watersheds with a high fraction of organic or impermeable soils, average stream TSP concentrations always exceeded the 10µg P/liter value often considered a critical threshold in accelerating eutrophication. Sediment P losses were less than 1 kg/ha from any watershed but comprised from 14 to 80% of watershed P loss. Increased watershed area of row cropping (predominantly corn, potatoes) was associated with increased soluble but not sediment P loss. Decreased sediment P loss occurred from watersheds with a higher proportion of permeable soils.

DATA:

Primary Source.

242. NIELSEN, G.H. and MACKENZIE, A.F.
1978: Relationships Between Soluble and Exchangeable Ca, Mg and K Lost from Agricultural Watersheds; Canadian Journal of Soil Sciences, Vol. 58, No. 4, p. 487-499.

ABSTRACT:

Seven agricultural watersheds in southeastern Ontario and southwestern Quebec with varying land uses and soil types were samples 14 times between 7 May 1974 and 21 May 1975. Discharge volume, suspended sediment concentrations and soluble and sediment ($NH_4OAc$ exchangeable) Ca, Mg and K concentrations were measured each time. Significantly decreased pK-1/2 p(Ca + Mg) values occurred in watersheds with more impermeable soils and greater corn and small grain land uses. The relatively higher stream K concentrations were attributed to K-enriched surface runoff and leaching loss from K fertilization of corn and small grains. Seasonal variations in the Gapon exchange constants or exchangeable cations associated with suspended sediment probably related to variation in surface soil erosion. Estimated annual soluble cation losses varied by watershed but were highest from watersheds with the largest proportions of corn, cultivated land and calcareous soils.

DATA:

Primary Source.

243. NOELS, B.
1981: Erosion/Sedimentation - Urban Lands; In: Erosion and Sedimentation in Ontario, a Time for Action, Some Papers from the Winter, Summer and Fall Meetings of the Ontario Chapter, Soil Conservation Society of America, Erosion and Sedimentation, a Fresh Look at the Problem in Ontario, February 11, 1977, Canada Centre for Inland Waters, Burlington, p. 8-11.

ABSTRACT:

This paper deals with remedial measures which must be undertaken by either the landowner, the municipality, the conservation authority, the province of Ontario or a combination of these agencies to reduce soil loss in the urban complex. Developmental activities on lands adjoining a watercourse will be reflected in the silt load introduced into the stream. Unless effective measures for erosion control are enforced, the costs of erosion control works and the resulting sedimentation removal will continue to multiply. Mississauga and Brampton are two cities within the Credit River Drainage Basin that are feeling the pressure of intensive development. The Credit Valley Conservation Authority gave approval to 43 new subdivisions in 1976, mainly in Brampton and Mississauga, placing some 2,000 acres off agricultural land in the urban complex. Some subdivisions cover hundreds of acres. Without sound planning practices and conservation measures, the effect of this development on watercourses in the area would be devastating. Developments may take more than one year to complete. Meanwhile the site will have experienced rainstorms and possibly one or more spring break-up. The site is generally rough graded to allow overland drainage at least until the storm sewers are in operation. The local watercourse will sweep away the sediment or choke trying to. If the area is vegetated, erosion is significantly reduced. Intensive development pressures usually mean expensive land which in turn means utilization of all land is necessary to keep the cost of housing down. Utilization of all possible land can lead to problems as far as watercourses are concerned. In recent years, the authority has undertaken extensive diversion and channelization works. Studies have been conducted for other erosion control problems throughout the watershed, particularly in intensely developed areas. To control erosion and siltation in developing areas sound planning and conservation practices on all future developments must be adopted and sound conservation principles must be applied to soil erosion and sedimentation problems. The value of conservation methods used in an area is reflected in the quality of the water found in the rivers and streams throughout that area.

DATA:

Primary Source.

244. NOVAK, Z. and WHITEHEAD, B.A.
1983: Urban Stormwater Quality, Devon Pilot Catchment, City of Stratford; Proceedings of the 6th Canadian Hydrotechnical Conference, Canadian Society for Civil Engineering, June 2-3, 1983, Ottawa, p. 979-999.

ABSTRACT:

Data on precipitation, stormwater runoff and runoff quality were collected for a wide range of hydrologic events from a typical urban catchment - Devon, in the City of Stratford. The data were analyzed to define precipitation/runoff/pollutant inter-relationships in order to characterize the typical runoff pollutant loadings on an event and seasonal basis.

The event pollutant loading increases with increasing runoff volume while the average event concentration decreases with increasing runoff volume. Smaller runoff events however, occur more frequently and as a result, contribute the major portion of the total seasonal pollutant loadings. Higher pollutant concentrations were found at the early stages of the runoff event.

Relatively small water quality ponds can effectively reduce seasonal pollutant loadings to a receiving stream by natural settling. These ponds can capture small runoff events plus the first portions of larger runoff events.

DATA:

Primary Source.

245. NRIAGU, J.O.
1983: Arsenic Enrichment in Lakes near the Smelters at Sudbury, Ontario; Geochimica et Cosmochimica Acta, Vol. 47, No. 8, p. 1523-1526.

ABSTRACT:

Roughly 200 tonnes of arsenic are produced annually with the base metal ores at Sudbury about 125 tonnes of which are released to the ambient environment via the atmosphere. The dispersion of this highly toxic element in lakes around the smelters is described. The total As concentrations in unfiltered lake waters vary from 0.2 to 0.6 ug $L^{-1}$. The suspended particulates in the water column (with As contents of 2-6 ug $g^{-1}$) play a major role in the flux of arsenic to the lake sediments. The present-day rates of As accumulation in the sediments are found to be 1.5-6.4 mg $m^{-2}yr^{-1}$; these rates exceed those of precolonial times by factors of 5-47. The changes in the rates of As flux to the sediments are shown to parallel the history of Cu and Ni production in the district.

DATA:

Primary Source.

246. NRIAGU, J.O. and COKER, R.D.
1983: Sulfur in Sediments Chronicles Past Changes in Lake Acidification; Nature, Vol. 303, No. 5919, p. 692-694.

ABSTRACT:

Sulphur pollution has closely been linked to the problems of acid precipitation and lake acidification. Although variations in sulphur isotopes can in principle be used to fingerprint the sources of sulphur in the lacustrine environment no attempt has so far been made to apply the technique in the study of pollutant sulphur in lakes in an historical sense. We report here the concentrations and isotopic composition of sulphur in sediments of several softwater lakes of northern Ontario. An objective of the study has been to ascertain whether the accumulation of sulphur in the sediments is related to the flux of pollutant sulphur into the lakes.

DATA:

Primary Source.

247. NRIAGU, J.O. and GAILLARD, J.-F.
1984: The Speciation of Pollutant Metals in Lakes Near the Smelters at Sudbury, Ontario; In: Environmental Impacts of Smelters, J.O. Nriagu, editor, Advances in Environmental Science and Technology, Wiley, Vol. 15, p. 349-374.

ABSTRACT:

In this chapter, the chemical interactions and the competition between pollutant metals and the different constituents of lakes around Sudbury are examined using computer-generated speciation models. The scavenging of trace metals by the suspended particulates is modelled by combining the adsorption model of Hem (1976) with the conditional exchange constants derived by the strategy of Balistrieri et al. (1981) for aquatic particulates. The novel features of our model include (1) the use of adsorption constants for multiphase, heterogeneous particulates; (2) the consideration of competition for adsorption sites on particulate surfaces by the major and trace metals; and (3) the inclusion of the adsorption of metal complexes by the suspended particulates. The subroutine for metal scavenging has linked to a general-purpose computer program, PHREEQE, which gives the distribution of the dissolved species, the saturation states of an aqueous phase with respect to specified mineral phases, and the amounts of specified phases transferred into or out of the aqueous system (Parkhurst et al., 1980). The field data from representative lakes near Sudbury were subsequently processed using the computer program and the outputs compared with the results of studies on the complexing capacities of these lake waters (Chau and Lum-Shue-Chan, 1974; Chau et al., 1974; Chau and

Wong, 1976), and with the particulate metal concentrations in the lakes (Nriagu et al., 1982).

DATA:

Secondary Source; refer to Nriagu et al. (1982).

248. NRIAGU, J.O. and SOON, Y.K.
1984: Arylsulphatase Activity in Polluted Lake Sediments; Environmental Pollution, Series B, Vol. 8, No. 2, p. 143-153.

ABSTRACT:

Arylsulphatase activities in a wide variety of lake sediments have been determined to see whether they can provide any clues on past changes in lake acidity or sediment quality. The enzyme activity generally decreases with depth in sediments, and often is independent of the concentration of sedimentary organic matter. There appears to be some relationship between arylsulphatase activity and (a) the pH of the lake water and (b) the metal pollution of the sediments. The inhibitory effect of copper, nickel and zinc is demonstrated and the possible role of this enzyme in the cycling of sulphur in recent lake sediments is discussed.

DATA:

Primary Source.

249. NRIAGU, J.O. and SOON, Y.K.
1985: Distribution and Isotopic Composition of Sulfure in Lake Sediments of Northern Ontario; Geochimica et Cosmochimica Acta, Vol. 49, No. 3, p. 823-834.

ABSTRACT:

Sediments from unpolluted and highly polluted lakes in northern Ontario have been fractionated into acid volatile sulfide, HCL-soluble sulfur, elemental sulfur, pyrite sulfur, ester sulfate and carbon-bonded sulfur and the isotopic composition of each fraction determined. In general, reduced inorganic S constitutes 25-50% of the total S in the polluted surficial sediments, but is <20% in the unpolluted samples, with pyrite formation being a minor process of S diagenesis in lake sediment ecosystems. Organic S in the form of ester sulfate and carbon-bonded S predominates and both the C/S ratios and the isotopic data suggest that, in unpolluted lakes, plant detritus can be a major contributor of organic-S to the sediments. The depth profiles observed suggest that the more labile ester sulfate is diagenetically converted to the carbon-bonded form. For the polluted sediments from the Sudbury basin, the isotopic data

suggest that (a) the elemental S is derived from the oxidation of acid volatile sulfide in the aerobic surficial sediments, and (b) the isotopically light reduced S species are incorporated into the organic material. S diagenesis in lake sediments generally results in the release of $^{34}S$ to the overlying water. The suggestion is made that sulfate concentrations over 5 mg/L accompanied by an enrichment of surficial sediments with isotopically different S may signal significant inputs of pollutant S into the lake and its basin.

DATA:

Primary Source.

250. NRIAGU, J.O. and WONG, H.K.
1983: Selenium Pollution of Lakes near the Smelters at Sudbury, Ontario; Nature, Vol. 301, No. 5895, p. 55-57.

ABSTRACT:

Mining and smelting of Cu-Ni ores at Sudbury, Ontario, release about 2 tonnes of Se to the environment per day. We show here that within a 30-km radius of Sudbury, the Se concentrations in the lake waters range from 0.1 to 0.4 μg $L^{-1}$; the Se contents of the suspended particulates in the lakes vary from ~2 to 6 μg per g. The Se profiles in the lake sediments generally parallel the history of Cu-Ni production in the district. The present-day rates of Se accumulation in the sediments are found to be 0.3-12 mg $m^{-2}yr^{-1}$. These current deposition rates exceed those of precolonial times by factors of 3-18, and are among the highest recorded anywhere in North America.

DATA:

Primary Source.

251. NRIAGU, J.O., WONG, H.K. and COKER, R.D.
1982: Deposition and Chemistry of Pollutant Metals in Lakes around the Smelters at Sudbury, Ontario; Environmental Science and Technology, Vol.16, No. 9, p. 551-560.

ABSTRACT:

Analyses of the suspended particulates in lakes within a 30-km radius of the smelting complex at Sudbury show average Ni, Cu, Zn, and Pb concentrations of 1500, 420, 540, and 360 μg $g^{-1}$, respectively. Organic matter constitutes 35-60% of the suspended material in the lakes but plays a minor role in the transport of metals to the sediments. The rates of metal accumulation in the sediments have been estimated typically to be 100-600, 50-300, 10-60, and 5-30 mg $m^{-2}year^{-1}$ for Ni, Cu, Zn, and Pb,

respectively. The enrichment factors for metals in surficial sediments typically are 12-115 for Ni, 10-77 for Cu, 2-10 for Pb, and 2-8 for Zn. These enrichment factors and deposition rates for Ni and Cu are among the highest recorded anywhere in the world. Some of the lakes with pH values of 4.5 of less show no enrichment or accumulation of pollutant metals in their surface sediments, indicating that pollutant metals previously stored in the sediments have since been leached away. This documentation that the contaminated sediments can release substantial quantities of toxic metals to the overlying water must have interesting ramifications with regard to the limnological impacts of acid rains.

DATA:

Primary Source.

252. OLIVER, B.G.
1973: Heavy Metal Levels of Ottawa and Rideau River Sediments; Environmental Science and Technology, Vol. 7, No. 2, p. 135-137.

ABSTRACT:

Sediment samples were collected at two-mile intervals along the Ottawa and Rideau Rivers near Ottawa, Canada, in July, 1971. The sediments were analyzed for lead, mercury, zinc, copper, nickel, cobalt, iron, manganese, and chromium using atomic absorption spectrophotometry. The surface areas of the samples were measured and taken into consideration when deciding whether or not metal levels were unusually high. Some anomalously high heavy metal concentrations found in the sediments in certain locations appeared to be related to pollution of the rivers by municipal and industrial waste water discharges and waste disposal practices.

DATA:

Primary Source.

253. OLIVER, B.G.
1984: Distribution and Pathways of Some Chlorinated Benzenes in the Niagara River and Lake Ontario; Water Pollution Research Journal of Canada, Vol. 19, No. 1, p. 47-58.

ABSTRACT:

Three major processes have been shown to be responsible for losses of chlorobenzenes, CB's, from water of the Niagara River and Lake Ontario - volatilization, sedimentation and discharge via the St. Lawrence River. The major losses (>80%) for all the CB's including hexachlorobenzene, HCB, were by volatilization. As would be predicted from chemical and physical properties, among

all the CB's, HCB has the lowest tendency to volatilize and the highest tendency to become associated with suspended sediments. A compartmental analysis of CB's in Lake Ontario revealed that the bulk of the CB's in the lake is in the bottom sediments. The bottom sediments in the lake have been shown to be prone to resuspension and become redistributed to all the major sedimentation basins in the lake. At least a portion of CB's associated with bottom sediments appears to be available to lake biota.

DATA:

Primary Source.

254. OLIVER, B.G. and AGEMIAN, H.
1974: Further Studies on the Heavy Metal Levels in Ottawa and Rideau River Sediments; Environment Canada, Inland Waters Directorate, Water Quality Branch, Scientific Series No. 37, 10 p.

ABSTRACT:

Sediment samples, collected at two-mile intervals on the Ottawa and Rideau Rivers in the summer of 1972, were analyzed for lead, mercury, zinc, copper, nickel, cobalt, iron, manganese, chromium, and cadmium by atomic absorption spectrophotometry. Unusually high levels of mercury were recorded near pulp and paper industrial discharges as a result of former use by the industry of mercurial slimicides. Elevated metal levels were found at sewage plant and storm sewer outfalls. This is to be expected as sewage contains a significant quantity of metals, especially in the particulate form. The removal of snow disposal sites away from the Rideau River lowered the lead sediment levels in this river in the city of Ottawa.

DATA:

Primary Source

255. OLIVER, B.G. and CHARLTON, M.N.
1984: Chlorinated Organic Contaminants on Settling Particulates in the Niagara River Vicinity of Lake Ontario; Environmental Science and Technology, Vol. 18, No. 12, p. 903-908.

ABSTRACT:

The concentrations of 26 chlorinated organic contaminants have been determined in settling particulates from sediment traps in Lake Ontario in the vicinity of the Niagara River and in two offshore stations. In addition, the same compounds have been analyzed in some Niagara River water and surficial Lake Ontario sediment samples. Compounds studied include chlorinated benzenes

and toluenes, some PCB congeners, several pesticides, and miscellaneous compounds such as mirex and octachlorostyrene. Contaminant profiles have been used to distinguish between freshly settling particulates and resuspended bottom sediments found in the traps from various depths. From the sediment trap and river contaminant data a crude estimate of the relative proportion of contaminants sorbed on settling particles in the vicinity of the river was made. For most compounds poor agreement was found when field sediment-water partition coefficients were compared to coefficients estimated from octanol-water partition coefficients.

DATA:

Primary Source.

256. OLIVER, B.G., COSGROVE, E.G. and CAREY, J.H.
1979: Effect of Suspended Sediments on the Photolysis of Organics in Water; Environmental Science and Technology, Vol. 13, No. 9, p. 1075-1077.

ABSTRACT:

An assessment of the role of suspended sediments and clays on the rate and mechanism of photolysis of pollutants in water was carried out. It was found that even though semiconductor powders such as $TiO_2$ could photocatalyze the decomposition of organics such as methyl alcohol and *p*-dichlorobenzene in water, no such reaction occurred with naturally occurring suspended sediments or clays. The sediments and clays were found to decrease the rate of phytolysis of pollutants such as methoxychlor by shielding the pollutant from the available light.

DATA:

Primary Source.

257. OLIVER, B.G. and KAISER, K.L.E.
1986: Chlorinated Organics in Nearshore Waters and Tributaries of the St. Clair River; Water Pollution Research Journal of Canada, Vol. 21, No. 3, p. 344-350.

ABSTRACT:

The concentrations of hexachloroethane (HCE), hexachlorobutadiene (HCBD), pentachlorobenzene (QCB), hexachlorobenzene (HCB) and octachlorostyrene (OCS) in large volume water samples show that the major sources of these chemicals to the St. Clair River are Dow Chemical Company effluents and, to a lesser degree, Sarnia's Township ditch which drains one of Dow's waste disposal sites. Tributaries entering the river on both side of the Canada/United States border contain measurable concentrations of these chemicals indicating low level contamination throughout the area. The

degree of water/suspended sediment partitioning of the chemicals ($K_p$) was studied. $K_p$ values for the individual chemicals changed in a manner consistent with changes in their physical-chemical properties.

DATA:

Primary Source.

258. OLIVER, B.G. and KELSO, J.R.M.
1983: A Role for Sediment in Retarding the Acidification of Headwater Lakes; Water, Air, and Soil Pollution, Vol. 20, No. 4, p. 379-389.

ABSTRACT:

Experiments conducted on selected minerals and headwater lake sediments showed that major acid neutralization reactions above pH 4.5 were reactions releasing $Ca^{2+}$ and $Mg^{2+}$ from the sediments. Analysis of the sediments and water from 97 headwater lakes in northern Ontario showed a predictable decrease in the exchangeable $Ca^{2+} + Mg^{2+}$ of the sediments with decreasing lakewater pH. Estimates of the total potential buffering capacity for the sediments above pH 4.5 and for water in these headwater lakes were made, and it was found that, even when only the top 1 cm of sediment is considered, a substantial sediment buffering reserve is available.

DATA:

Primary Source.

259. OLIVER, B.G. and KINRADE, J.
1972: Heavy Metal Concentrations in Ottawa River and Rideau River Sediments; Scientific Series No. 14, Environment Canada, Inland Waters Directorate, 10 p.

ABSTRACT:

Sediment samples were collected at two or three mile intervals along the Ottawa River from Ottawa to Thurso, and along the Rideau from Smith Falls to Ottawa from July 19 to 24, 1971. Using atomic absorption spectrophotometry the sediments were analyzed for lead, mercury, zinc, copper, nickel, cobalt, iron, manganese, and chromium. Some of the high concentrations of heavy metals found in the sediments of these rivers appear to be from pollution by municipal and industrial wastewater discharges and waste disposal practices.

DATA:

Primary Source.

260. OLIVER, B.G. and PUGSLEY, C.W.
1986: Chlorinated Contaminants in St. Clair River Sediments; Water Pollution Research Journal of Canada, Vol. 21, No. 3, p. 368-379.

ABSTRACT:

The concentrations of many chlorinated organics including chlorobenzenes, hexachloroethane, hexachlorobutakiene, octachlorostyrene, carbon tetrachloride, and perchloroethylen have been measures in an extensive number of bottom sediment samples from the St. Clair River. The sediment data pinpointed major sources of contaminations in the Sarnia industrial area and demonstrated widespread downstream contamination to Lake St. Clair.

DATA:

Primary Source.

261. O'NEILL, J.E.
1979: Pollution from Urban Land Use in the Grand and Saugeen Watersheds; Report, Task Group C (Canadian Section), Activity 3, PLUARG, International Joint Commission, Windsor, 55 p.

ABSTRACT:

Under the IJC-PLUARG program, seven urban study areas in the Grand River and Saugeen River pilot watersheds were studied between 1974 and 1977, namely Kitchener - Waterloo - Cambridge, Schneider Creek, Montgomery Creek, Guelph, New Hamburg, Durham and Allan Park. The pollutants identified in runoff from these urban areas were: total phosphorus, metals (lead, copper, chromium), chloride, organic chemical and bacteria. The pollutant problems were greatest (in terms of unit-area loads) in the most urbanized areas at the Schneider Creek, Montgomery Creek, Kitchener - Waterloo - Cambridge and Guelph sites. No significant pollutant contributions were measured in the least urbanized areas at New Hamburg, Durham and Allan Park.

The main sources of pollution in urban areas appear to be residential and commercial land and industrial point sources. A major pathway by which pollutants enter receiving waters in urban areas is thought to be the wash-off of accumulations of airborne-derived contaminants from impervious surfaces. Residential and industrial construction sites, where the vegetative cover has been removed, and areas where on-site protection measures have not been undertaken appear to be sources of greatly increased sediment and sediment-associated pollutant loads.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

262. ONGLEY, E.D.
1973: Sediment Discharge from Canadian Basins into Lake Ontario; Canadian Journal of Earth Sciences; Vol. 10, No. 1, p. 146-156.

ABSTRACT:

Regional patterns of sediment yield from Canadian watersheds tributary to Lake Ontario are obtained by manipulating suspended and dissolved sediment and flow data originally obtained by government for other purposes.

DATA:

Secondary Source; refer to Water Survey of Canada and Ontario Ministry of the Environment data.

263. ONGLEY, E.D.
1974: Hydrophysical Characteristics of Great Lakes Tributary Drainage, Canada; Unpublished Report, Task Group D, Activity 2.1, PLUARG, International Joint Commission, Windsor, 5 volumes, 1211 p.

ABSTRACT:

Although the immense reservoir characteristic of the Great Lakes produces relative hydrologic stability, it also serves to retain and concentrate material discharging from tributary drainage. In view of diverse physical and cultural characteristics of the Great Lakes watershed, the purpose of this report is to provide data to enable identification of spatial patterns of river discharge and water quality for all Canadian tributaries draining into each of the Great Lakes. In addition, basic geologic and geomorphologic information is compiled for each tributary watershed. With the exception of Appendix I, the report omits data for tributaries draining to waterways connecting the Great Lakes.

Appendix I contains geographic, geomorphologic and landform description of basins included in Appendices II and III, plus basins added in 1973 to the provincial monitoring system. Appendices II and III, which tabulate discharge and water quality records, include all basins for which discharge and/or water quality data are available to December 31, 1972.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

264. ONGLEY, E.D.
1976: Sediment and Nutrient Yield from Great Lakes Tributary Drainage, Canada; Geoscience Canada, Vol. 3, No. 3, p. 164-168.

ABSTRACT:

The role of tributary drainage, as one primary source of sediment and nutrient loads to the Great Lakes, is outlined within the context both of historic cultural impact on land drainage and of relative importance of contemporary point and diffuse sources. Regional trends and patterns of sediment, nutrient and chloride yields to the four Canadian Great lakes are created from Ontario Ministry of the Environment period-of-record water quality surveillance data fields collected at or near the mouths of 102 rivers and creeks. Limitations both of raw data and analyses employed herein are briefly explored. Denudational equivalents should be used with caution.

DATA:

Secondary Source; refer to Water Survey of Canada and Ontario Ministry of the Environment data and Stichling (1973).

265. ONGLEY, E.D.
1976: Hydrophysical Characteristics of Great Lakes Tributary Drainage, Canada: Evaluation of Loadings from Tributary Waters to the Great Lakes and Interconnecting Channels; Unpublished Report, Task Group D, PLUARG, International Joint Commission, Windsor, 227 p.

ABSTRACT:

This report continues the work for PLUARG Task D and contains a contract work statement, "raw data sets" status report, and water quality and loadings calculations for interconnecting waterways.

It was recommended that Task D continue its assessment of loadings data both within the framework of concentration-discharge relationships and as additional PLUARG information becomes available. It has been noted that verification of surveillance data can be performed on only five watersheds and only for suspended sediment. It is imperative that other quality parameters be checked against the more exhaustive but temporally limited Task C data sets.

The Task D data bank is sufficiently complete to subject the data to multivariate analysis in order to examine linkages between water quality attributes and independent variables such as land use, overburden, geology, discharge, etc. These linkages will form the foundation for extrapolation (modelling) using the Task B future projections of land use.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

266. ONGLEY, E.D.
1976: Sediment Yields and Nutrient Loadings from Canadian Watersheds Tributary to Lake Erie: An Overview; Journal of the Fisheries Board of Canada, Vol. 33, No. 3, p. 471-484.

ABSTRACT:

Mean annual loadings and unit yields for sediment, phosphorus, nitrogen, and chloride have been calculated for 19 river-mouth locations on the Canadian side of Lake Erie for the period 1967-72. Data, drawn from routine monitoring data files of Federal and Provincial agencies, are discussed in terms of biases inherent in such monitoring programs. Unit yields are only marginally related to basin substrate texture but show pronounced storage characteristics within basins for sediment and sediment-bound nutrients. It is suggested that there is a minimum threshold size of basin below which nutrient runoff is relatively unaffected by basin storage and uptake.

DATA:

Secondary Source; refer to Water Survey of Canada and Ontario Ministry of the Environment data.

267. ONGLEY, E.D.
1977: Study of Statistical Evaluation and Update of Data Bank with Discharge and Water Quality Data for the Great Lakes Interconnecting Channels and Associated Tributaries; Unpublished Report, Task Group D (Canadian Section), PLUARG, International Joint Commission, Windsor, 91 p.

ABSTRACT:

This status report includes a statement of data file organization, activities pertaining to statistical analysis, an overview of current work status and a summary of loadings data for the period of record to 1974. No effort was made to reproduce earlier information contained in the 1974 report.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

268. ONGLEY, E.D.
1978: Land Use, Water Quality and River Mouth Loadings: A Selective Overview for Southern Ontario; Report, Task Group D (Canadian Section), Activity 2.1, PLUARG, International Joint Commission, Windsor, 110 p.

ABSTRACT:

This report is based upon a long-term PLUARG program in the Department of Geography at Queen's University under the auspices of Canadian Task D, for the assembly, management and analysis of data holdings pertinent to the assessment of regional trends for the Canadian side of the Great Lakes. These assessments have in the past involved computations of tributary loadings of a variety of nutrients, solids, contaminants and other water quality attributes; the evaluation of routinely available data for the purpose of developing regional trends; the statistical analysis of water quality-land use relationships and the development both of file management and of analytical methods for Task D purposes. The work performed under this program appears in a series of reports to (Canadian) PLUARG Task D of the International Joint Commission.

This report, although limited to selected results of a statistical evaluation of phophorus trends and of land use-water quality interactions, contains enough primary information to permit full understanding without recourse to earlier reports. The study is intended primarily as a source document to be used with other PLUARG information in the preparation of the final PLUARG report, dealing with evaluation of regional trends of loadings and land use linkages and the development of remedial strategies. Therefore, much of the information is presented with explanatory notes but with little detailed comment for, prior to receipt of technican reports from other PLUARG activities, detailed synthesis at this stage in terms of remedial programs would be premature. It should also be noted that many relationships found among variables are noted herein but left unexplained because they are beyond this writer's experience.

Although PLUARG is primarily interested in substantive results, the multivariate analysis of the Task D data bank held at Queen's University has provided insight into analytical procedures involving regional data sets. Therefore, in addition to substantive conclusions drawn from the analysis, methodological experience gained through care and handling of this data bank is germane to potential post-PLUARG activities. It seems likely that future land use-water quality models for regional public policy development will involve a statistical component in which data of the type used here are the best likely to be available for regional analysis.

In most of the work reported here, aggregate basin characteristics are compared with mean (usually mean annual) river-mouth load and/or concentration data. Although solids data, which are particularly susceptible to seasonal (and event) hydrologic variations, have been assessed for seasonal resolution, land use-water quality linkages are here assesses using mean annual data. Sufficient data do exist to explore seasonal linkages; however, there are good scientific and statistical reasons for

refraining from doing so until the distributed data within individual basins can be fully exploited.

DATA:

Secondary Source, refer to Ontario Ministry of the Environment data.

269. ONGLEY, E.D.
1982: Influence of Season, Source and Distance on Physical and Chemical Properties of Suspended Sediment; Proceedings of the Symposium on the Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, Exeter, July 19-30, 1982, International Association of Hydrological Sciences, IASH-AISH Publication No. 137, p. 371-383.

ABSTRACT:

Understanding of source, pathways and fate of suspended sediment-associated nutrients and contaminants is now recognized as an important element of water resource management. The geochemically active fraction (<62 μm) of the suspended sediment load concentrates nutrients, metals and organic contaminants by several orders of magnitude above ambient water concentrations. Because this sediment fraction tends to be flow dependent, is not depth dependent nor adequately characterized by bottom sediments, collection of suspended sediment for geochemical purposes requires new sampling strategies. Mineralogy and major element analysis together with systematic seasonal changes in physical characteristics of suspended matter can assist in identifying seasonally variant source areas. Changes in sediment chemistry during downstream transport reflect a suite of biogeochemical processes which should be explicitly considered when assessing the environmental relevance of sediment quality.

DATA:

Secondary Source; refer to Water Survey of Canada data.

270. ONGLEY, E.D. and BRAEKHOVEN, L.H.
1979: Data Filtering Techniques and Regional Assessment of Agricultural Impacts Upon Water Quality, Southern Ontario; Progress in Water Technology, Vol. 11, No. 6, p. 551-577.

ABSTRACT:

The study examines the effect of agriculture relative to other land uses upon river water quality at a regional level using 49 nonpoint (diffuse) source and 52 point source drainage basins in Southern Ontario, and which are tributary to Lakes Ontario, Erie, Huron and connecting waterways. Methods of data filtering are

examined and substantive relationships amongst river water quality and categories of land use are identified. Water quality data are mean annual concentration for the period 1968-72 for nutrients and other physical and chemical variables. Land use variables employ a reduced set of Canada Land Inventory categories which include agricultural and urban variables. Filtering techniques include correlation, factor and discriminant analyses. Factor analysis does not effectively group these variables. Alternatively discriminant analysis offers a rapid and convenient method for identifying those independent variables responsible for variations in water quality. Correlation is used to examine those relationships amongst variables which are identified by discriminant analysis. Although urban variables appear to be responsible for extremely high levels of total nitrogen, and total and soluble phosphorus found in a few basins, cropland appears to influence levels of those attributes in basins representing the top one-third of ranked mean annual values. Cropland is the single discriminating variable for basins having large suspended sediment concentrations and is strongly related to nitrate levels.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

271. ONGLEY, E.D., BYNOE, M.C., and PERCIVAL, J.B.
1981: Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario. Canadian Journal of Earth Sciences, Vol. 18, No. 8, p. 1365-1379.

ABSTRACT:

To understand the nature of sediment-associated nutrient and contaminant transport dynamics in fluvial systems, a stormflow sampling program of suspended solids is reported for one water year in a representative rural diffuse source catchment of southeastern Ontario. Bulk samples of subsieve suspended solids were obtained using field-portable continuous-flow centrifuge apparatus. The physical and geochemical properties of suspended solids show no significant intersite differences over reaches of 1500-2000 m, yet display distinctive seasonal trends. Systematic seasonal changes in particle size, organic content, and Ca, P, Mn, Al, Ti, Fe, and K appear to reflect the changing role of partial area hydrology. Ca, P, and Mn are bioaccumulated by stream algae. Mineral signature is relatively constant over the year.

DATA:

Secondary Source; refer to Bynoe (1979).

272. ONGLEY, E.D., RALSTON, J.G. and THOMAS, E.L.
1977: Sediment and Nutrient Loadings to Lake Ontario: Methodological Arguments; Canadian Journal of Earth Sciences, Vol. 14, No. 7, p. 1555-1565.

ABSTRACT:

Environmental issues frequently require values for sediment and nutrient loads in river systems. Except in rare instances, such values must be drawn from existing surveillance data which may not reflect sampling strategies pertinent to the issue at hand. In particular, the time variant and nonlinear relationships between discharge and both suspended sediment and sediment-related parameters such as phophorus cannot be captured in detail by surveillance data. Nevertheless, such data collected routinely by the Ontario Ministry of the Environment accurately reflect the relative loadings both in terms of unit and total yields in five basins where detailed suspended sediment data are available. Although surveillance data underestimate the absolute values of suspended sediment loads calculated from detailed sediment information, these data do capture the relative monthly and seasonal contributions to annual suspended sediment load. A comparison of three methods for calculating annual unit and total loadings of suspended and solute components from surveillance information indicates that annual mean data convey information which is not significantly less adequate than monthly aggregations of data.

DATA:

Secondary Source; refer to Water Survey of Canada and Ontario Ministry of the Environment data.

273. ONTARIO MINISTRY OF THE ENVIRONMENT
1972: Water Quality Study of the Lower Spanish River; Report, 50 p.

ABSTRACT:

This report presents the findings of investigations of the effects of wastewater discharges from the Kraft mill of Eddy Forest Products Limited and the Town of Espanola primary sewage treatment plant on the Lower Spanish River.

Most of the water quality information contained in the report was obtained from an intensive investigation of the area during August 1971 by the Water Quality Surveys Branch of the OWRC. In addition, data from earlier studies in 1965 and 1967 and a biological study in 1967 were used to complement the findings of the 1971 survey. These studies were requested by the OWRC Divisions of Industrial Wastes and Sanitary Engineering to provide information on the environmental effects of wastewaters as part of their on-going pollution abatement programs in the province.

Following a description of the water pollution problems, the report presents a set of water quality standards which would provide water quality suitable for multiple uses including recreation and the protection of fish and other desirable aquatic life. The control measures necessary for achieving these standards are also discussed.

DATA:

Primary Source.

274. ONTARIO MINISTRY OF THE ENVIRONMENT
1975: Data for Northern Ontario Water Resources Studies 1972-1973; Water Resources Bulletin 1-5, 234 p.

ABSTRACT:

This bulletin is limited to the presentation of data gathered by the Ministry of the Environment during the years 1970 to 1973. Ontario agreed to undertake a series of coordinated studies of Ontario's Northern Water Resources and related economic development. Most of the work is being undertaken in five large river basins draining to Hudson Bay and James Bay. This bulletin is one in a general series.

DATA:

Primary Source

275. ONTARIO MINISTRY OF THE ENVIRONMENT
1975: Lake Simcoe Basin. A Water Quality and Use Study; Report, 143 p.

ABSTRACT:

Lake Simcoe due to its proximity to the Province's largest population centres, its generally excellent water quality and its suitability for a wide variety of water-oriented activities is one of Southern Ontario's prime cottaging and recreational areas. For many of the same reasons, it is also one of the more desirable areas for urban and industrial development.

The increasing pressure for urbanization and the desire to protect the recreational value of one of southern Ontario's largest lakes led the Ontario Ministry of the Environment to conduct a five-year study into the status of water quality and water use of Lake Simcoe. Preliminary studies in Kempenfelt Bay were conducted during the summer of 1970 and the intensive basin-wide program was initiated in the spring of 1971 and continued in 1972. The investigation was designed to meet the following objectives:

1. To determine the present state of water quality throughout the lake basin.

2. To identify sources of pollution, measure the magnitude of each source and determine its effects on water quality;

3. To catalogue water uses throughout the basin; and

4. To develop a water quality management guide for the protection of Lake Simcoe waters.

It should be pointed out that the particular emphasis of this study was directed to the preservation and, wherever necessary, restoration of the water quality of the lake. It is recognized that many localized water quality problems do exist; in fact, several were identified in the course of the investigations and are discussed in this report. These localized problems, as they are identified have been, or will be, dealt with individually by staff of the Central Region of the MOE or other appropriate authorities.

As part of this report, an evaluation of the Lake Simcoe fisheries prepared by the Lake Simcoe Fisheries Assessment Unit of the Ministry of Natural Resources has been included.

DATA:

Primary Source.

276. ONTARIO MINISTRY OF THE ENVIRONMENT
1976: Kettle Creek Watershed - Surface Water Quality and Waste Loading Guidelines; Report, Technical Support Section, Southwestern Region, 66 p.

ABSTRACT:

This report illustrates that inadequate streamflow is available throughout the watershed to sufficiently dilute municipal or industrial wastes discharges continuously through the summer low-flow period. At Belmont on upper Kettle Creek and at the Ford Company of Canada Limited plant on Dodd Creek, background streamflow can be non-existent during the six-month interval from May to October. Below St. Thomas, design sewage flows are expected to exceed natural streamflow most of the time between June and October.

Because of these low streamflows, receiving waters were found to be unsuitable for most uses other than waste assimilation particularly on Dodd Creek downstream from the Ford Company of Canada Limited plant and on Kettle Creek downstream from St. Thomas. Dissolved oxygen concentrations failed to meet the Ministry criterion of 5 mg/ℓ for 8 to 10 miles of Dodd Creek below the Ford Talbotville plant and at the majority of sampling points from St. Thomas to Port Stanley. Populations of aquatic organisms were seriously disrupted in both these reaches although

recovery to upstream condition was complete at the mouth of Dodd Creek and upstream from the St. Thomas sewage treatment facilities.

DATA:

Primary Source.

277. ONTARIO MINISTRY OF THE ENVIRONMENT
1978: Extensive Monitoring of Lakes in the Greater Sudbury Area, 1974-1976; Sudbury Environmental Study Report, Water Resources Assessment, Northeastern Region, 40 p.

ABSTRACT:

The metal smelting industry located at Sudbury, Ontario constitutes one of the world's largest single contributors of $SO_2$ to the atmosphere. In addition, large amounts of other contaminants, including heavy metals, are emitted annually from the Sudbury smelters. Through the mechanisms of precipitation and dry fallout, atmospherically conveyed materials originating from smelting activity become available of surface waters in the Sudbury area. From the aspect of potential damage to aquatic environments, two major concerns, lake acidification and heavy metal disposition, are associated with the Sudbury smelter emissions.

Due to highly resistant geological settings (Precambrian Shield) most of the lakes in the greater Sudbury area are dilute, oligotrophic waters with limited acid buffering ($H^+$ assimilation) capacity. In these dilute lakes, even relatively small additions of $H_2SO_4$, via the atmosphere, are sufficient to cause significant pH reductions. In lakes subjected to acidic loadings, the inherent buffering capacity appears more important in determining the resultant pH than the absolute $H^+$ input.

Of the 209 lakes investigated during the present study, 20% had calcite saturation indices ( a measure of $H^+$ assimilative capacity) indicating that they are critically acidified (pH < 5.0). An additional 50% had CSI's indicating vulnerability to acidic inputs.

The distribution of low pH lakes (pH < 5.5) exhibits a distinct northeast-southwest trend from the smelting centre, reflecting the prevailing winds of the area and highly resistant local geology. This low pH zone-of-effect occupies an area of 5,300 $km^2$. Withing this zone, which includes 30% of the study lakes, significant loss and depression of fish populations have occurred.

The distribution of metals in the study lakes provides a further concern relative to impacts on aquatic biota. Sediment and aqueous concentrations of nickel and copper showed significant elevations associated with smelting activity, while cadmium, lead,

iron and zinc concentrations appeared to be controlled primarily by geological factors. From a toxicity viewpoint, copper was the only metal reaching toxic concentrations (in 2% of the study lakes), however, it should be noted that zinc concentrations exceeding M.O.E. criteria for protection of fish and aquatic life were recorded in 15% of the lakes.

Although the metal concentrations in the study lakes in most cases do not appear directly problematic, the potential additive or even synergistic effects of elevated metal concentrations and low pH on aquatic biota are concern.

DATA:

Primary Source.

278. ONTARIO MINISTRY OF THE ENVIRONMENT
1978: Water Quality Data Collected for the Pollution from Land Use Activities Reference Group (PLUARG) Study 1975, 1976 and 1977; Report, Task Group C, PLUARG, International Joing Commission, Windsor, 500 p.

ABSTRACT:

The Ontario Ministry of the Environment developed a monitoring network in support of the PLUARG study. In addition to the monitoring sites for the specific land uses in support of Task C activities, main stem monitoring sites were also established at existing streamflow stations.

Samples were analyzed for some or all of the following parameters: counts of total and fecal coliforms, enterococci and background count; concentrations of suspended solids, total phosphorus, filtered reactive phosphate, total dissolved phosphorus, total Kjeldahl nitrogen, filtered (nitrate + nitrite) nitrogen, filtered ammonia nitrogen; levels of conductivity and turbidity; concentrations of total carbon, total inorganic carbon, total organic carbon, filtered organic carbon, filtered chloride, filtered alkalinity, filtered sulphate, filtered reactive silicate, filtered calcium, filtered magnesium, filtered potassium and filtered sodium, units of pH, concentrations of henols, total zinc, total lead, total cadmium, total copper, total iron, total nickel, total chronium, total mercury and total arsenic. Limited available information on manganese, selenium, pesticides and PCB's can be obtained from the Ministry's Water Resources Branch offices in Toronto.

A basic annual summary, i.e. the number of samples and average concentrations is presented for each monitoring station. In addition to a verbal station location description, the Universal Transverse Mercator Grid (UTM) is provided along with a hydrologic (Storet-type) coding system.

DATA:

Primary Source.

279. ONTARIO MINISTRY OF THE ENVIRONMENT
1979: St. Clair River Organics Study, Biological Surveys 1968 and 1977; Report Water Resources Assessment Unit, Technical Support Section, 90 p.

ABSTRACT:

A marked improvement in water quality as reflected by bottom fauna production has occurred between 1968 and 1977 in the St. Clair River.

A resurgence of bottom-dwelling life forms was evident in the nearshore waters along the Canadian shoreline as evinced by increased numbers and a greater variety of taxa, along with a reduction of the degradation zone of the river. A considerably reduced zone of severe impairment was still evident in 1977 along the Canadian shoreline where benthic organisms generally accepted as sensitive to pollution were absent and those most tolerant to pollution were predominant. Wastes discharged from Canadian sources were found to impact only on nearshore Canadian waters and biota since the strong currents of the shipping channel do not allow for detectable transboundary movement.

It is considered that the recovery of bottom fauna has been a direct result of reductions in the volume and improvements in the quality of industrial and municipal discharges to the river along the Canadian shoreline.

Field observations and the results of sediment analyses revealed that the St. Clair sediments were contaminated with organic compounds such as PCBs, oil and heavy metals and supported excessive growths of bacterial slimes and aquatic plants.

Elevated concentrations of PCBs in river sediments were documented during 1976, 1977 and 1978. Owing to the lack of historical information it is not possible to establish whether these values were previously of greater magnitude, assuming that the declining trend noted for mercury as a result of translocation processes would also apply to PCBs. The presence of high concentrations of PCBs in the sediments is of particular concern because of the detection of PCBs in the flesh of several species of fish from the St. Clair River, Lake St. Clair and Lake Huron at concentrations which exceed the guideline established for this contaminant to protect human health.

Aesthetically the surface waters of the St. Clair River have improved substantially since the initial investigations in 1968. Although spills and discharges of petroleum compounds were observed to remain a common occurrence, a qualitative comparison showed the St. Clair River to be visually much cleaner than in 1968. A number of the spills observed in 1977 originated from commercial shipping traffic.

DATA:

Primary Source.

280. ONTARIO MINISTRY OF THE ENVIRONMENT
1981: Water Quality Data, Ontario Lakes and Streams, 1980; Water Resources Volume XVI, Water Quality Data Series, 657 p.

ABSTRACT:

This publication presents the water quality data collected by the ministry. Parameters include suspended solids, metals, trace elements, pH, alkalinity.

DATA:

Primary Source.

NOTE: This publication is published annually. The first contained data collected during 1965-66.

281. ONTARIO MINISTRY OF THE ENVIRONMENT
1982: Studies of Lakes and Watersheds near Sudbury Ontario: Final Limnological Report; Report SES 009/82, 2 volumes.

ABSTRACT:

Volume 1 of this report (the Ontario Ministry of the Environment's Sudbury Environmental Study) summarizes the results of data collected from 7 Sudbury area lakes between 1973 and 1979, and includes physical, chemical and where applicable, biological data, from the lakes, their associated streams and from precipitation falling on these lakes. Volume 2 provides a comprehensive summarization of all the available physical, chemical, hydrological and biological data collected during the study. Also included in this volume are detailed descriptions of the methods of sample collection and analysis, lake morphometry and the geology of the lakes and their watersheds.

DATA:

Primary Source. Refer to paper by P.J. Dillon and P.J. Smith Sediment Chemistry and Rates of Sedimentation in Lakes near Sudbury, Ontario (chapter 3 of report).

282. ONTARIO MINISTRY OF THE ENVIRONMENT
1982: A Water Quality Assessment of Kenogamisis Lake, District of Thunder Bay; Report, Municipal and Private Abatement Section, northwestern Region, 13 p.

SUMMARY:

The Ontario Ministry of the Environment conducted a water quality survey of Kenogamisis Lake, District of Thunder Bay, during the first six months of 1981. This followed a preliminary

investigation of potential arsenic and cyanide contamination, conducted during the summers of 1979 and 1980. Samples of lake water and domestic drinking water supplies were collected and analyzed to determine if there was any water quality impairment as a result of previous mining activity and the resultant deposition of tailings in and adjacent to the lake. Iron and manganese were found to exceed Ministry drinking water objectives (0.3 and 0.05 mg/L respectively), in the waters adjacent to the tailings deposits. Those waters found to contain elevated metal levels are not being utilized as drinking water supplies. Sampled drinking waters, taken from the lake, all contained traces of arsenic; however, none exceeded the Ministry's drinking water rejection criterion of 0.05 mg/L As. Data collected over the past three years suggest that the arsenic concentration in Kenogamisis Lake has decreased. This, however, may not be the result of a long-term stable reduction, but rather due to overall climatic and hydrogeologic factors. Cyanide was not detected in the waters of Kenogamisis Lake.

DATA:

Primary Source.

283. ONTARIO MINISTRY OF THE ENVIRONMENT
1984: Stratford-Avon River Environmental Management Project; Final Report, 97 p.

ABSTRACT:

This final report for the Stratford-Avon River Environmental Management Project represents the culmination of comprehensive urban, rural and in-stream studies initiated in April, 1980, at the request of the City of Stratford.

Active field investigations, remedial demonstrations, monitoring and technical analyses were largely completed in 1980 and 1981. By the establishment of an Advisory Committee, formal public contacts were maintained throughout the duration of the project with municipal representatives, the Perth County Federation of Agriculture and the Perth County Soil and Crop Improvement Association. Development of a preferred pollution control strategy, preparation of supporting technical documents nd meetings with thepublic and elected officials were carried out during 1982, the latter to assist in formulating an overall strategy that would hopefully gain general acceptance for future implementation.

Principal funding for the Stratford-Avon River Environmental Management Project was afforded by the Ministry of the Environment. However, a planning and investigational approach involving three task-oriented sub-committees - Rural, Urban and Stream Management, was made possible through the co-operative efforts of many individuals representing a number of agencies.

Most of the work on rural components of the study was achieved through a contract arranged with the Upper Thames River Conservation Authority. Other contributions to sub-committee activities were made by staff of the City of Stratford, the Lands Directorate of Environment Canada, the Perth County Soil and Crop Improvement Association, the Ministry of Natural Resources, the ministry of Agriculture and Food, the Upper Thames River Conservation Authority and the Ministry of the Environment. Lists of persons serving on the three sub-committees and the Management and Advisory Committees for the project are included in the Appendix.

DATA:

Primary Source; Also Refer to Dickinson (1982), Graham and Knight (1983) and Fortin et al. (1983)

284. ONTARIO MINISTRY OF THE ENVIRONMENT
1985: Inventory of Industrial Point Source Discharges in the Great Lakes Basin, Ontario - 1983: Report, 102 p.

ABSTRACT:

In this report the Ministry is providing information on some 100 industrial facilities in the Great Lakes basin whose treated wastewater discharge inputs directly to one of the Great Lakes, to one of the inter connecting channel or to a Great Lakes tributary watercourse. This compilation includes all industries considered to have potential impact on Great Lakes water quality.

The inventory has been prepared by the Ministry of the Environment under the direction of the Board of Review for the Canada-Ontario Agreement on Great Lakes Water Quality for submission to the International Joint Commission in fulfillment of the requirements of Article VI 1(c) of the 1978 Great Lakes Water Quality Agreement. The inventory which is updated annually and identifies industrial sources and processes, reports effluent loadings and loading limits and comments on the status of the abatement programs.

DATA:

Primary Source.

285. ONTARIO WATER RESOURCES COMMISSION
1970: Summary Report on the Mercury Pollution of the St. Clair River System; 13 p.

ABSTRACT:

This report summarizes the sources, nature and known effects of mercury losses to the St. Clair River and the remedial action

taken to date; outlines the conclusions to be drawn from present investigations; and recommends a future course of action to reduce the existing mercury pollution. Emphasis is given to the practicability of removing mercury-laden sediments from the St. Clair River.

DATA:

Primary Source.

286. ONTARIO WATER RESOURCES COMMISSION and QUEBEC WATER BOARD
1971: Ottawa River Basin. Water Quality and its Control in the Ottawa River; Report, 2 volumes, (vol. 1 - 120 p.) (vol. 2 - 234 p.).

ABSTRACT:

This report presents the findings of the joint study undertaken recently by Ontario and Quebec of the pollution of the Ottawa River. It is an investigation of the effects on water quality of the variety of uses of water in the basin and the controls required for restoration and maintenance of the quality of the river for the future. The information upon which the report is based was compiled by the Ontario Water Resources Commission and the Quebec Water Board over a three year period commencing in 1967.

DATA:

Primary Source.

287. OSTRY, R.C.
1979: Data Collection Methodology Used in the Study of Pollution from Land Use Activities in the Grand River and Saugeen River Pilot Watersheds; Report, Task Group C, PLUARG, International Joint Commission, Windsor, 70 p.

ABSTRACT:

Data-collection techniques employed in the Ministry of the Environment's PLUARG monitoring program were documented to ensure that the findings and conclusions based on these data could be compared and evaluated with data from other studies.

Water-quantity, water-quality and sediment-quality measurements conducted in the monitoring program were used to provide quantitative estimates of pollutant mass transport for the following uses: agriculture, urban, transportation and utility, sanitary landfill, processed organic waste, extractive industries and private waste disposal.

Continuous records of water level were obtained from streamflow gauging stations and relationships between stage and discharge for each station were developed in order to compute continuous

discharge. Rainfall intensity and daily, total rainfall measurements were obtained using a network of tipping bucket and standard rain gauges. Ground-water sampling points were installed and monitored to determine the impairment of ground-water quality in the vicinity of selected study sites. The sediment-quality monitoring program was designed to measure the quality of fluvial sediments and soils.

Emphasis in the water-quality monitoring program was placed on the collection of samples when surface runoff (resulting from rainfall events or snow and ice melt) transported pollutants from the surface of the land to the tributary channel. Water samples were collected in the vicinity of the investigated land-use activities to determine the pollutant contribution from that land use. In addition, the surface-water monitoring network was expanded to unmonitored areas of the pilot watersheds to trace the movement of pollutants to the boundary waters.

Soil analyses were undertaken to quantify the attenuation rates of nutrients, inorganic trace contaminants and organic trace contaminants on lands used for sanitary landfill, private waste disposal and the application of processed organic waste as fertilizer. Suspended-sediment quality was measured to determine the percentage of contaminants carried by sediment and to estimate the mass transport of some contaminants, i.e. PCB's, which often occur in water below the analytical detection limit. Measurement of bed-material quality was also undertaken to determine the degree of sediment impairment in the vicinity of the investigated land uses.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

288. OSTRY, R.C. and TSENG, T.
1981: A Preliminary Method for Evaluation of Non-Point Sources; An Assessment Procedure Prepared for the Working Group II of the Water Management Steering Committee, Ontario Ministry of the Environment, Water Resources Branch, hydrology and Monitoring, 13 p.

ABSTRACT:

This paper compiles available information on the characteristics of non-point pollution sources, and representative unit-area loads for major land uses, and presents an approach that could be used to estimate the relative magnitude of point and non-point sources inputs to receiving water bodies in Ontario. Dominant land use categories discussed are urban general, rural general, and wooded/idle. Comparisons and ranges of unit area loads (Kg/Ha/Yr) for the major land uses are given for total phosphorus, filtered

reactive phosphorus, total nitrogen, suspended sediment, chloride, lead, zinc, and copper. The general workability of the proposed approach is detailed for six river basins (Little Pic River, Magpie River, Duffins Creek, Bonnechere River, Grand River, and Saugeen River) of varying size across Ontario. Results suggest that the approach can be used to provide a reasonable first approximation of the non-point source contamination for any watershed. It is concluded that accuracy can be significantly improved if local knowledge and understanding of the study area is used in selecting more representative values from the ranges provided for the major land uses in each watershed.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

289. OTTAWA RIVER PROJECT GROUP
1979: Mercury in the Ottawa River; Environmental Research, Vol. 19, No. 2, p. 231-243.

ABSTRACT:

The Ottawa River Project, a 5--year study of the distribution and transport of mercury in a stretch of the Ottawa River, is summarized. Significant observations include the rapid clearance of mercury from the sediments (half-line on the order of 1 year), the utility of partition coefficients for the description of mercury distribution between sediment and water, the use of plants as indicators of inorganic and organic forms of mercury in water, and the general predictability of methylmercury levels in fish.

DATA:

Secondary Source; refer to Miller (1977).

290. OTTO, J.
1983: Sedimentology of the Sixteen Mile Creek Lagoon, Niagara Peninsula, Ontario, Canada; Unpublished M.Sc. Thesis, Department of Geological Sciences, Brock University, St. Catharines, 167 p.

ABSTRACT:

The effects of relative water level changes in Lake Ontario were detected in the physical, chemical and biological characteristics of the sediments of the Fifteen, Sixteen and Twenty Mile Creek lagoonal complexes. Regional environmental changes have occurred resulting in the following sequence of sediments in the three lagoons and marsh. From the base up they are; (1) Till, (2) Pink Clay, (3) Bottom Sand, (4) Gyttja, (5) Orange Sandy Silt, (6) Brown Clay and (7) Gray Clay. The till was only encountered in

the marsh and channel; however; it is presumed to occur throughout the entire area. The presence of diatoms and sponge spicules, the vertical and longitudinal uniformity of the sediment and the stratigraphic position of the Pink Clay indicate that it has a glacial or post-glacial lacustrine origin. Overlying the Pink Clay or Till is a clay, silty sand to gravel. The downstream fining and unsorted nature of this material indicate that it has a fluvial/deltaic origin. Water levels began rising in the lagoon 3,250 years ago resulting in the deposition of the Gyttja, a brown, organic-rich silty clay probably deposited in a shallow, stagnant environment as shown by the presence of pyrite in the organic material and relatively high proportions of benthic diatoms and grass pollen. Increase in the rate of deposition of the Gyttja Twenty Mile Creek and a decrease in the same unit on Sixteen Mile Creek is possibly the result of a capture of the Sixteen Mile Creek by the Twenty Mile Creek. The rise in lake level responsible for the onset and transgression of this unit may have been produced by isostatic rebound; however, the deposition also corresponds closely to a drop in the level of Lake Huron and increased flow through the lower lakes. The Orange Sandy Silt, present only in the marsh, appears to be a buried soil horizon as shown by oxidized roots, and may be the upland equivalent to the Gyttja.

Additional deepening resulted in the deposition of Brown clay, a unit which only occurs at the lakeward end of the three lagoons. The decrease in grass pollen and the relatively high proportion of pelagic diatoms are evidence for this. the deepening may be the result of isostatic rebound; however, the onset of its deposition at 1640 years B.P. is synchronous in the three lagoons and corresponds to the end of the subAtlantic climatic episode. The effects of th climatic change in southern Ontario is uncertain. Average deposition rates of the Brown Clay are similar to those in the upper Gyttja on Sixteen Mile Creek; however, Twenty Mile Creek shows lower rates of the Brown Clay than those in the upper Gyttja. The Gray Clay covers the present bottom of the tree lagoons and also occurs in the marsh. it is interlaminated with sand in the channels. Increases in the rates of deposition, high concentrations of Ca and Zn, an Ambrosia rise, and an increase in bioturbation possibly due to the activities of the carp, indicate that this unit is a recent deposit resulting from the activities of man.

DATA:

Primary Source.

291. OXBY, B.
1980: Investigation of Reservoir Sedimentation in Earl Rowe Provincial Park; Unpublished B.A. Thesis, Department of Geography, University of Waterloo, Waterloo, 116 p.

ABSTRACT:

Not available at time of publication.

292. PATTERSON, R.J., FRAPE, S.K., DYKES, L.S. and McLEOD, R.A.
1978: A Coring and Squeezing Technique for the Detailed Study of Subsurface Water Chemistry; Canadian Journal of Earth Sciences, Vol. 15, No. 1, p. 162-169.

ABSTRACT:

A coring squeezing technique has been modified and simplified to permit the collection of closely spaced samples of pore water from both the saturated and unsaturated zones on land, and bottom sediments in lakes and rivers. Samples of the pore water are obtained by placing short sections of sediment from freshly collected cores in a mechanical squeezer and applying pressure to extrude the contained fluid into a syringe. If coarse incompressible sediments are encountered, the pore water is removed by an immiscible-fluid displacement technique. The pore water samples are analyzed by standard methods for major and minor components. Also, in situ measurements of some parameters are carried out by directly inserting electrodes into the fresh sediment. These methods are being applied at a number of locations in southern Ontario to study the quality of waters in the unsaturated zone, the chemistry of natural and contaminated groundwaters, and the significance of seepage and baseflow in lakes and rivers respectively.

DATA:

Primary Source.

293. PERCIVAL, J.B.
1979: The Spatial and Temporal Flux of Sediment-Related Phosphorus, Clay Mineralogy and Soluble Anions in Wilton Creek, Southeastern Ontario; Unpublished M.Sc. Thesis, Department of Geography, Queen's University, Kingston, 195 p.

ABSTRACT

Suspended solids were collected at four sites some 1500-2000 m apart in Wilton Creek, Ontario for one open-water year (1977). The sediments were sampled during spring melt and storm runoff events by continuous-flow centrifugation. The sediments were analyzed for clay mineralogy and phosphorus content, and their spatial and temporal trends were assessed. Soluble anions (phosphorus, nitrate as nitrogen, sulphate and chloride) in filtered water samples were also analyzed.

Only minor (quantitative) variation in clay mineralogy of the suspended sediments was detected. Vermiculite, illite, quartz, and K-feldspar are present in both the clay-size and fine silt-size fractions. Plagioclase, expandable clay minerals, kaolinite, chlorite and amphibole are present in most samples. Mixed layer 10 to 14 A (1.0-1.4 mm) clay minerals are common in

clay-size fractions; calcite and dolomite are rare in all samples. The clay mineralogical composition of the suspended sediments, bed, bank and soil samples is similar, precluding definitive interpretation of provenance of the suspended sediments for any season.

Sediment-related phosphorus parameters exhibit strong seasonal trends. Apatite phosphorus concentrations peak in early spring and decline through the remainder of the year. Nonapatite inorganic phosphorus reaches a maximum concentration in late summer, whereas organic phosphorus peaks in late spring and only declines in early fall. Nonapatite inorganic and organic phosphorus show strong correlation with organic matter content, whereas correlation with particle size is variable. Inorganic and total phosphorus show similar trends to nonapatite inorganic and organic phosphorus.

During summer the particle size of the suspended solids fraction is in excess of 80% clay-size material, while organic matter content is also high but variable. Since mineralogical composition is constant throughout the year, the increase in concentration of nonapatite inorganic and organic phosphorus in the summer may be related to high concentrations of organic matter in the suspended fraction and/or to the increase in the quantity of fine-grained material.

Total phosphorus in suspension ($TP_S$) concentration is maximum in early spring, decreases sharply in late spring, then gradually increases throughout the remainder of the year. Soluble reactive phosphorus shows a similar trend to total phosphorus in suspension but total dissolved phosphorus ($TDP_S$) remains essentially constant throughout the year. Soluble reactive phosphorus, never more than 25% of $TP_S$, appears to be residual value during growth periods of algae.

Nitrogen as nitrate concentration appears proportional to discharge and is therefore a function of the amount of runoff occurring in the basin. Chloride and sulphate are governed by groundwater inputs. nitrate and chloride also show site variation possibly reflecting increased land use practices between sites A and B.

The phosphorus and soluble anion data generally show seasonal dependency but no between-site variation. The clay mineralogy data exhibit no major seasonal or site variation. Transmission effects are not observed over short distances, but may be evident over long distances.

The conventional method of estimating the amount of particulate-associated phosphorus ($TP_S - TDP_S$) reflects the suspended sediment flux in Wilton Creek over the year and is adequate for measuring flux of phosphorus. The concentration of total phosphorus in the centrifuge-recovered suspended sediment

fraction, however, reflects the changing role of suspended sediments with respect to organic content and particle size throughout the year. Monitoring strategies and suspended sediment sampling techniques designed for a particular objective may not, therefore, be satisfactory for other purposes.

DATA:

Primary Source.

294. PERSAND, D., LOMAS, T., BOYD, D. and MATHAI, S.
1985: Historical Development and Quality of the Toronto Waterfront Sediments-Part I; Report, Ontario Ministry of the Environment, Water Resources Branch, Great Lakes Section, 66 p.

ABSTRACT:

Part I of the Toronto Waterfront Sediment assessment is designed to show the historical formation and development of Toronto nearshore sediments and to provide good baseline information on contaminant levels in the sediments sampled between the period of 1976 to 1983. Preliminary studies were reported by the Ministry in 1974.

The analytical results presented are evaluated in light of the Ministry Dredged Material Disposal Guidelines (1976). These Guidelines are used routinely to assess the suitability of dredged material for open lake disposal. Parameter values in excess of the numerical Guidelines suggest that contamination of sediment has taken place while sediments with parameter values less than the guidelines are considered clean and acceptable for open water disposal.

High levels of contaminations were found in sediments of Humber Bay, the Inner Toronto Harbour and Ashbridges Bay. However, it must not be construed that parameters with levels in excess of MOE guidelines will have a discernible impact on water quality or aquatic organisms. The significance of contaminant levels with respect to potential impacts will be examined in Part II of this study (1985).

The water supplies at both the R.C. Harris and the Island filtration plants were monitored during recent years to determine any potential impacts of contaminated sediment movement from dredging and lakefilling activities. The results have shown no discernible effects attributable to sediment movements since water supplies at both plants remain of excellent quality.

DATA:

Primary Source.

295. PLATFORD, R.F., MAGUIRE, R.J., TKACZ, R.J., COMBA, M.E. and KAISER, K.L.E. 1985: Distribution of Hydrocarbons and Chlorinated Hydrocarbons in Various Phases of the Detroit River; Journal of Great Lakes Research, Vol. 11, No. 3, p. 379-385.

ABSTRACT:

Concentrations of several chlorohydrocarbons, polychlorinated biphenyls, and polynuclear aromatic hydrocarbons in the Detroit River were measured. For purposes of this study, the river ecosystem was divided into six phases or compartments: sediments, pore water in the sediments, suspended solids, subsurface water, surface microlayer, and air. Significant amounts of the above mentioned compounds occur in all of these compartments except air (for which our detection was relatively insensitive). The sediments contained over 99% of the chlorinated compounds. The polynuclear aromatic hydrocarbons were distributed between the subsurface water and the sediments.

DATA:

Primary Source.

296. PUGSLEY, C.W., HEBERT, P.D.N., WOOD, G.W., BROTEA, G. and OBAL, T.W. 1985: Distribution of Contaminants in Clams and Sediments from the Huron-Erie Corridor. I-PCB's and Octachlorostyrene; Journal of Great Lakes Research, Vol. 11, No. 3, p. 275-289.

ABSTRACT:

Samples of surficial sediments and the clam species Lampsilis radiata siliquoidea were collected from 102 sites covering all of Lake St. Clair and the Canadian shoreline of the St. Clair and Detroit rivers. The distribution patterns of both octachlorostyrene (OCS) and PCBs were mapped throughout this area. The mean level of PCBs in sediments of 3.9 $\mu g\ kg^{-1}$ (Aroclor 1254) was much lower than values for "total PCBs" reported in studies carried out in the early 1970s. This reduction does not appear to reflect a real decrease in PCB levels in the environment, but rather changes that have been made in sampling procedures and analytical techniques. Highest levels of PCBs in both sample types were found along the western shore of Lake St. Clair. Mean levels of OCS in whole clam tissue and surficial sediment (0-10 cm) were 43.0 and 5.1 $\mu g\ kg^{-1}$, respectively. The distribution pattern of OCS in the Huron-Erie corridor in both clams and sediments suggests that the primary source is in the St. Clair River. The mean chemical concentration factor was 59 for OCS, indicating considerable bioaccumulation in the biota of Huron-Erie corridor.

DATA:

Primary Source.

297. RAMAMOORTHY, S. and RUST, B.R.
1976: Mercury Sorption and Desorption Characteristics of some Ottawa River Sediments; Canadian Journal of Earth Sciences, Vol. 13, No. 4, p. 530-536.

ABSTRACT:

Bed sediments of the Ottawa River downstream of the Gatineau River confluence are predominantly sandy, with variable organic contents, chiefly wood chips. Mercury sorption by these sands was studied at constant temperature using a mercuric-ion specific electrode, and varying added ($Hg^{2+}$) and pH. Sorption rates are highest for organic-rich sands, but variation in particle size is apparently not sufficient to reveal sorption rates are highest for organic-rich sands, but variation in particle size is apparently not sufficient to reveal sorption trends related to this parameter. Sorption data were fitted to a linear form of the Langmuir equation, from which sorption maxima and mercury bonding coefficients were derived. The maxima do not vary between samples, whereas the bonding coefficient relates most closely to organic content. Mercury sorption was little affected by pH.

Desorption rates are low: less than 1% Hg was leached from sediment after 70 h agitation in distilled water, and a similar amount in fulvic acid solution. The mercury-sediment bonding is evidently much stronger than that between fulvic acid and mercury, irrespective of organic content of the sediment.

DATA:

Primary Source.

298. RAMAMOORTHY, S. and RUST, B.R.
1977: Heavy Metal Exchange Processes Occurring in Sediment-Water Systems; In: Distribution and Transport of Pollutants in Flowing Water Ecosystems, D.R. Miller, editor, Final Report of the Ottawa River Project, p. 9.1-9.29.

ABSTRACT:

The present study was started as a pilot project to investigate the mercury sorption and desorption characteristics of six Ottawa River bed sediments (Fig. 9.1, 1973 samples; Ramamoorthy & Rust 1976). The initial mercury concentrations used in the experiments ranged from those which might be expected in pulp mill effluents, to much higher values that permit determination of maximum sorption capacities of the sediments under conditions of gross mercury overloading. Other experimental variables were pH, time, and sediment type (grain size, specific surface area, cation exchange capacity, and organic content). Data on sorption of Hg, Cd, Cu and Pb by Ottawa River bed sediments can be fitted to the linear form of Langmuir's equation. High values of bonding energy

constant and sorption maximum show that the sediments have a substantial capacity to sorb heavy metal ions. These parameters correlate directly with organic content and mean grain size. pH variation does not significantly affect the sorption maximum of the sediments. Insignificant Hg desorption occurred during sample agitation for 70 hours in either distilled water or fulvic acid. High rates of desorption of Hg, Cu, Cd, and Pb resulted from leaching samples with NaCl and Nitrilotinacetate solutions. The two leachates give rise to approximately equal desorption of mercury. Desorption of mercury is increased by the presence of another heavy metal ion (Cd, Pb, Cu) in a greater than order-of-magnitude concentration.

DATA:

Primary Source.

299. RAMAMOORTHY, S. and RUST, B.R.
1978: Heavy Metal Exchange Processes in Sediment-Water Systems; Environmental Geology, Vol. 2, No. 3, p. 165-172.

ABSTRACT:

Experimental data for sorption of Hg, Cd, Cu, and Pb by sand, silt, and organic-rich sediments from the Ottawa River, Canada show significant conformity to Langmuir's equation. Values of the bonding energy constant and the sorption maximum correlate directly with organic content and mean grain size ($\phi$). Desorption experiments indicate that the heavy metals form stable complexes in nitrilotriacetate (NTA) and NaCl Solutions, with the following desorption ratios: Hg, 1:1 ((Cl-:NTA); Pb, 1:10; Cd, 1:2 Serial and batch desorption studies under various conditions show that the cation-exchange order in the sediments is Hg>Pb>Cu>Cd. For a given heavy metal the partition coefficient between sediment and solution is not greatly changed by the presence of another cation, provided the latter has the same order of concentration. If, the concentration of one cation exceeds another by more than 10, however, significant desorption of the less concentrated ion takes place on a mass action basis.

DATA:

Primary Source.

300. RAMAMOORTHY, S., SPRINGTHORPE, S. and KUSHNER, D.J.
1977: Competition for Mercury Between River Sediment and Bacteria; Bulletin of Environmental Contamination and Toxicology, Vol. 17, No. 5, p. 505-511.

ABSTRACT:

This paper deals with a laboratory experiment to demonstrate the relative capacity to bind mercury between Ottawa River clays and

bacteria. Results show that bacteria accumulated up to twenty times more Hg that the sediment after 72 hours.

DATA:

Primary Source.

301. RAO, S.S., BHASKAR, L. and JURKOVIC, A.A.
1982: Microbiological Studies of some Watersheds Receiving Acid Precipitation in Canada; Turkey Lakes Watershed Unpublished Report No. TLW-82-04, 93 p.

ABSTRACT:

This report presents results (data and interpretation) of studies on microbial populations and their activities in lake waters and sediments in the Turkey Lakes Watersheds and the Kejimkujik Watershed, N.S. Field monitoring and laboratory fermentor experiments are both reported. Bacterial activity was found to be depressed in acid stressed lakes.

DATA:

Primary Source.

302. RAO, S.S. and DUTKA, B.J.
1983: Influence of Acid Precipitation on Bacterial Populations in Lakes; Hydrobiologia, Vol. 98, No. 2, p. 153-157.

ABSTRACT:

Relative abundance of total, respiring, aerobic heterotrophic, nitrogen cycle and sulfur cycle bacteria was measured in acid stressed and non-acid stressed hard water lakes. Data indicated that bacterial populations and densities were nearly an order of magnitude less in acid stressed waters than in non-acid stressed waters. Nitrifying bacteria and some sulfur cycle bacteria (Thiobacillus sp.) were very low or absent in acid stressed waters. Surface sediments of acid stressed lakes contained 3 to 4 times more organic matter than the amount found in the relatively more enriched lake. Methodology and data are presented.

DATA:

Primary Source.

303. RAO, S.S., JURKOVIC, A.A. and NRIAGU, J.O.
1984: Bacterial Activity in Sediments of Lakes Receiving Acid Precipitation; Environmental Pollution, Series A, Vol. 36, No. 3, p. 195-205.

ABSTRACT:

Bacteriological data for water and sediment cores from some of the lakes receiving acid precipitation near Sudbury, Ontario, show a strong relationship between lake acidification and bacteria. pH values below about 5.5 appear to be critical for respiring and aerobic heterotrophic bacteria. Total bacteria in the waters of these lakes existed in the $10^6$ $ml^{-1}$ range while the viable or active populations were approximately two orders of magnitude lower. In the sediments, a relationship was demonstrated between pH, bacterial populations, sediment microbial activity, and total organic matter. In the acid-stressed Silver Lake (pH 3.8) the sediment respiration was 10-20% of that in the non-acid-stressed McFarlane Lake (pH 7.2). Associated with this, a strong correlation was demonstrated between pH and total organic matter in surficial sediments.

DATA:

Primary Source.

304. RAO, S.S., JURKOVIC, A.A. and ROBSON, P.
1982: Effects of Acid Precipitation on Microbial Populations in Northern Ontario Lakes; Turkey Lakes Watershed Unpublished Report No. TLW-82-03, 65 p.

ABSTRACT:

This report summarizes the methodology used and the bacteriological data collected from surveys of lakes water and sediments in the Turkey Lakes Watershed from May to October 1980.

DATA:

Primary Source.

305. RASID, H. and OOSTERVELD, M.
1985: Morphologic Effects of Channelization: the Case of the Neebing-McIntyre Floodway, Thunder Bay, Ontario, Canada; Environmental Management, Vol. 9, No. 5, p. 399-416.

ABSTRACT:

The Neebing-McIntyre floodway in Thunder Bay, Ontario, Canada, has been constructed with a relatively straight and uniform trapeziodal channel, compared with the prechannelized sinuous reaches of the Neebing and the McIntyre rivers. The flow regime of the floodway also contrasts significantly with the prechannelized regime, because of the combination of discharges from these rivers into a new channel and the regulation of flows by a diversion structure. The maximum channel capacity of the

floodway is about 284 $m^3s^{-1}$ (175 year regional flood) compared with about 40 $m^3s^{-1}$ and 60 $m^3s^{-1}$ respectively, for the Neebing and the McIntyre. According to regime theories, the construction of a straight and trapezoidal channel has upset the equilibrium of the stream system and therefore should lead to some accelerated erosion and sedimentation processes in the new channel immediately after construction. Erosion potential is particularly high during higher discharge events, when flow velocities are expected to be greater than the prechannelized velocities of the Neebing and the McIntyre. The overall sediment yield of the watershed is low (71 $km^{-2}yr^{-1}$), compared with other documented watersheds of North America, but the rates of deposition in the floodway are relatively high, mainly due to the backwater effect of Lake Superior. Unless maintained by constant channel work, the floodway will tend to fill up with sediment, until a postconstructional equilibrium is reestablished.

DATA:

Primary Source.

306. RAST, W. and GREGOR, D.J.
1979: Report on Differences in Great Lakes Phosphorus Load Estimates; Report Submitted to the Great Lakes Pollution from Land Use Activities Reference Group of the International Joint Commission, 27 p.

ABSTRACT:

A review of the 1976 Great Lakes phosphorus load estimates developed by the Pollution From Land Use Activities Reference Group (PLUARG), the Water Quality Board (WQB) and Task Group III (TG) (the bilateral technical group which developed phosphorus Target Loads for the Great Lakes as part of the Fifth Year Review of the United States - Canadian Water Quality Agreement) was conducted. The load estimates were examined to determine the sources of differences between estimates and, where possible, to explain the reasons for the differences.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

307. RICHARDS, N.R.
1981: History of Erosion and Sedimentation Control Programs in Ontario; In: Erosion and Sedimentation in Ontario, a Time for Action, some Papers from the Winter, Summer and Fall Meetings of the Ontario Chapter, Soil Conservation Society of America, Erosion and Sedimentation, a Fresh Look at the Problem in Ontario, February 11, 1977, Canada Centre for Inland Waters, Burlington, p. 3-7.

ABSTRACT:

Not available at time of publication.

DATA:

Secondary Source.

308. ROBINSON, J.B., WHITELEY, H.R., STAMMERS, W., KAUSHIK, N.K. and SAIN, P.
1979: The Fate of Nitrate in Small Streams and Its Management Implications; In: Best Management Practices for Agriculture and Silviculture, R.C. Loehr, D.A. Haith, M.F. Walter and C.s. Martin, Editors, Proceedings of th 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Ltd, Ann Arbor, Michigan, p. 247-259.

ABSTRACT:

This paper provides further evidence for significant amounts of nitrogen loss during transport in streams and indicates the stream management options which should enhance the process.

DATA:

Secondary Source; refer to the Sain et al. (1977).

309. ROBINSON, M.W.
1972: Sediment Transport in Canadian Streams: A Study in Measurement of Erosion Rates, Magnitude and Frequency of Flow, Sediment Yield and Some Environmental Factors; Unpublished M.A. Thesis, Department of Geography, Carleton University, Ottawa, 318 p.

ABSTRACT:

This work examines the effect of basin size upon suspended sediment yields, erosion rates, and the proportion of suspended sediment moved by flows equalled or exceeded 1 per cent of the time. It is also an attempt to establish a first approximation of environmental factors responsible for basin sediment yield and to determine the effectiveness of flood flows upon basin morphology.

Spatial variation of yield, and of total erosion rates from basin to basin is investigated for 66 stream gauging stations including a common time comparison with respect to 11 stations. The 66 basins drain different regions of Canada from British Columbia to Prince Edward Island varying in basin size from .5 to 324,009 $km^2$. The 11 'representative' basins drain parts of Ontario, Manitoba, Saskatchewan and Alberta, and vary in drainage area from 9.40 to 324,009 $km^2$.

The investigation is accomplished by using a combination of bivariate correlation and linear regression, calculation of water and sediment discharge yields by class, Chi-Square distribution and Kolmogorov-Smirnov tests. All data were supplied by the Sediment Survey and other sections of the Water Survey of Canada, Department of the Environment.

Suspended sediment supply, measured in terms of sediment-concentration is computed using daily mean flow data to give suspended yields. Magnitude and duration distributions were significantly different between each research basin, and within each stream there was significant seasonal differentiation. The erosion rates for these stations ranged from 5.6 to 80.1 $mm/10^3yr.$ in the 11 research basins.

The magnitude-frequency analysis shows that the moderate flows do the greatest proportion of work but higher flood flows are slightly more effective than some of those studies by Leopold et al. 1964.

DATA:

Secondary Source; refer to Water Survey of Canada data.

310. ROY, A.C.
1979: The Water Quality of Selected Lakes in the Arctic Watershed of Ontario; Ontario Ministry of the Environment Northeastern Region and Water Resources Branch, Water Resources Report 11c, 95 p.

ABSTRACT:

As part of the Northern Ontario Water Resources Study carried out by the Ministry of the Environment from 1965 to 1972, water quality and phytoplankton data were collected from selected lakes in the five large river basins, (Moose, Albany, Attawapiskat, Winisk and Severn) that drain into Hudson Bay and James Bay (Arctic Watershed).

This report utilizes data from 28 lakes and bogs that were studied intensively to characterize the water quality of the various lakes within the study area. On the basis of morphology, water chemistry and phytoplankton populations, the 28 lakes are divided into five general groups. Three groups consisting of a total of sixteen lakes illustrate the general characteristics of lakes on the Precambrian Shield. One group consisting of three bogs and another group consisting of nine lakes illustrate the general characteristics of bogs and lakes on the Hudson Bay and James Bay Lowland.

DATA:

Primary Source.

311. RUDD, J.W.M. and TURNER, M.A.
1983: The English-Wabigoon River System: II. Suppression of Mercury and Selenium Bioaccumulation by Suspended and Bottom Sediments; Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 12, p. 2218-2227.

ABSTRACT:

Bioaccumulation of $^{203}Hg$ and $^{75}Se$ by several members of the food chain, including fish, was followed in large in situ enclosures in the presence and absence of organic-poor sediment. When the sediment was absent, $^{203}Hg$ was bioaccumulated 8- to 16-fold faster than when it was either suspended in the water or present on the bottom of the enclosures. Mercury-contaminated and uncontaminated sediments were equally effective at reducing the rate of radiolabelled mercury bioaccumulation, apparently by binding the mercury to fine particulates making it less available for methylation and/or bioaccumulation. Based on these results, a mercury ameliorating procedure involving semicontinuous resuspension of organic-poor sediments with downstream deposition onto surface sediment is suggested. The presence of sediments, in the water or on the bottom of enclosures, also reduced radiolabelled selenium bioaccumulation. The degree of inhibition (2- to 10-fold) may have been related to the concentration of organic material in the predominantly inorganic sediments. Implications of this research with respect to mercury-selenium interactions in aquatic ecosystems are discussed.

DATA:

Primary Source.

312. RUDD, J.W.M., TURNER, M.A., FURUTANI, A., SWICK, A.L. and TOWNSEND, B.E.
1983: The English-Wabigoon River System: I. A Synthesis of Recent Research with a View towards Mercury Amelioration; Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 12, p. 2206-2217.

ABSTRACT:

Over a 3-year period, teams from the federal Department of Fisheries and Oceans, the federal Department of the Environment, and the Ontario Ministry of the Environment researched the mercury pollution problem of the English-Wabigoon River system, northwestern Ontario, Canada. Mercury methylation and bioaccumulation were occurring mainly in the water column and surface layers of the sediments. Most mercury in the system was buried below the surficial sediments and probably does not contribute substantially to present mercury bioaccumulation. Movement of mercury between geochemical and biological compartments was rapid within the water column and surface sediments. Also, substantial amounts of inorganic and methyl

mercury were transported down the river-lake system having been released from stretches of river upstream of Clay Lake and deposited onto the surfaces of downstream lake sediments. Because of the constant movement of mercury into the water and onto downstream surface sediments, mercury amelioration procedures should concentrate on reducing bioaccumulation rates from both the water column and surface sediments. Treatments such as a single addition of clean clay to the surface sediments of lakes would probably be unsuccessful as long as significant downstream movement of mercury continues. Semicontinuous resuspension of bottom sediments followed by downstream deposition and/or elevation of the selenium concentration in biota by low-level additions of selenite were found to be the two most promising amelioration strategies. Both of these approaches would treat the problem in the water column and surface sediments. We consider advantages and disadvantages of these ideas and some needs for further research.

DATA:

Secondary Source; refer to Department of Fisheries and Oceans data.

313. RUDRA, R.P., DICKINSON, W.T. and WALL, G.J.
1985: Application of the CREAMS Model in Southern Ontario Conditions; Transactions of the ASAE, Vol. 28, No. 4, p. 1233-1240.

ABSTRACT:

A modified version of the CREAMS model has been calibrated with research plot data on loam soil in Southern Ontario. The modifications include the introduction of seasonal variations in soil erodibility and in soil hydraulic conductivity. The calibration has involved the determination of a set of model parameters to achieve an optimal fit of runoff, soil loss, and phosphorus yield estimates for up to a five year period of record. The hydrology submodel and the soluble phosphorus component of the nutrient submodel fared reasonably well. The performance of the erosion submodel was erratic but within acceptable limits. The particulate phosphorus component of the nutrient submodel did not fare so well.

DATA:

Secondary Source; refer to Water Survey of Canada and Ontario Agricultural College data.

314. RUKAVINA, N.A.
1986: Bottom Sediments and Morphology of the Upper St. Clair River; Water Pollution Research Journal of Canada, Vol. 21, No. 3, p. 295-302.

ABSTRACT:

New data on bottom sediments and bathymetry provide a more detailed picture of the physical character of the Upper St. Clair River Channel than was previously available. The data indicate that the channel has a complex erosional mid-section cut in glacial deposits and a steep inshore slope with a veneer of modern sediments. Deposits along the Canadian industrial shoreline consist of a thin wedge of nearshore sediment overlying a stiff glacial clay. Estimated volume of the deposit is 63 000 $m^3$; average texture is 63% sand, 32% gravel and 5% silt-clay. Tarry interstitial material occurs at or near the surface in the shallow-water cores. Size data from surface samples show two strong modes - a sand mode which is consistent with either local derivation of bedload transport and a gravel mode which appears to be too coarse to be natural sediment and may represent fill.

DATA:

Primary Source.

315. RUST, B.R.
1977: Physical Characteristics and Transport of Bed Sediments; In: Distribution and Transport of Pollutants in Flowing Water Ecosystems, D.R. Miller, editor, Final Report of the Ottawa River Project, p. 5.1-5.39.

ABSTRACTS:

The mineral composition of sand sized bed sediment in the study area indicates a major contribution from the Gatineau River. The principal organic loading is from the Ottawa River, while the Rideau appears to contribute little bed sediment to the study area. Silt and clay sized fractions are similar to those of pleistocene champlain sea clay, but are minor in the bed sediments of the study area. Geographic variation in grain size can be expressed best in terms of mean size and standard deviation. There is a close relationship between particle size and water depth (and in turn, flow velocity) within the study reach. Asymmetric bedforms are abundant, the most important being straight crested dunes, located in the central part of the main channel, and reaching up to 3 m in amplitude. Dune amplitude varies directly with water depth, as does dune index (amplitude/length). Index is also related to mean grain size and bed gradient. The dunes are permanent features on the bed, but actively migrate only during spring flood each year, for a period varying from about 2 weeks (1975) to 2 months (1974). The rate of bedload transport measured by sonar tracking of dunes and diver operated sampler was about 4 times ten to the fith power kg per day during the second week of June 1974. The calculations indicate a threshold for bed sediment movement (presumably the dune migration threshold) at a discharge of about 2650 cu m per

sec. Total bedload transport in spring 1974 was about 8.3 times ten to the seventh power kg, approximately ten times that of 1975.

DATA:

Primary Source.

316. RUST, B.R.
1977: The Distribution of Sediment-Associated Mercury; In: Distribution and Transport of Pollutants in Flowing Water Ecosystems, D.R. Miller, editor, Final Report of the Ottawa River Project, p. 6.1-6.49.

ABSTRACT:

The input of mercury into upper reaches of the Ottawa River from mining source and from bedrock appears to be insignificant. Size fractionation of sediments from the study area (silty sands with significant amounts of organic material) shows that minimum concentrations of iron and mercury are present in mid-sized fractions. This is thought to be due to organic fragments concentrating in coarser size fractions, while increased surface area in finer fractions results in higher heavy metal contents. Regression analyses of sediments from the study area show that most of the variation in mercury content can be explained in terms of the amount of organic material. A lesser degree of mercury variation can be explained in terms of grain size difference. These is strong correlation between iron and mercury concentration, and iron correlated better with grain size and organic content. Sharp peaks in mercury concentration at Masson, Thurso and Hawkesbury are related to pulp mills at these locations. Differences between the study reach and others reported in the literature are mainly due to coarse texture and the widespread distribution of wood fragments in the study section. Cores show that highest mercury concentrations in marginal sediments tend to occur at depths of 10 to 50 cm. Mechanisms of mercury loss from bed sediment are interpreted as mainly mechanical transport and dilution in the case of channel sands, and principally chemical desorption from finer channel margin sediments. Curves of mercury loss from 1972 to 1976 indicate rapid initial loss from sands, later flattening off as background levels are approached, with more uniform rates of depletion in the finer sediments.

DATA:

Primary Source.

317. RUST, B.R. and WASLENCHUK, D.G.
1974: The Distribution and Transport of Bed Sediments and Persistant Pollutants in the Ottawa River, Canada; Proceedings of the International Conference on Transport of Persistent Chemicals in Aquatic Ecosystems, Ottawa, May 1-3, 1974, p. I25-I40.

ABSTRACT:

The mineralogy of bed sediments in a three-mile reach of the Ottawa River east of Ottawa indicates that the tributary Gatineau River is the main source of inorganic sediment to the study reach. Mean grain size is closely related to water depth and flow velocity; medium to coarse clean sands occupy the deeper central channel, while medium to fine silty sands are present near the shores. Organic content generally related to sediment texture, with higher values in the finer sediment, but the widespread distribution of wood chips tends to obscure this relationship.

Concentrations of iron, manganese and mercury in surface coatings on grains are inter-related with Hg:Mn:Fe about $1:10^3 10:^4$. Sediment grain size in part controls iron concentration, and the latter appears to control manganese and mercury concentrations. Fe concentration is also affected by current velocity, such that greater Fe concentrations are present under quiescent rather than fast flowing conditions. Heavy metal concentrations also appear to correlate with wood chip content, because of their high porosity and relative surface area.

Dunes up to 3.0 m high are present on non-cohesive beds where water depth is greater than 5 m. Sonar tracking of migrating dune crests and a diver-operated sampler give close agreement on a bedload discharge of about $4.0 \times 10^5$ kg/day in mid-June 1974, when flow was about 75% of peak runoff. The associated transport rate for absorbed mercury is about 10 g/day.

Mercury levels in bed sediment appear to be decreasing by about 50% per year. For clean mid-channel sand this loss is achieved by mechanical transport of detrital grains with absorbed mercury, and by chemical desorption. Finer sediments at channel margins are subject to a much lower sediment transport rate, but are losing comparable amounts of mercury; in this case chemical desorption must be the principal mechanism.

DATA:

Primary Source.

318. RUST, B.R. and WASLENCHUK, D.G.
1976: Mercury and Bed Sediments in the Ottawa River, Canada; Journal of Sedimentary Petrology, Vol. 46, No. 3, p. 563-578.

ABSTRACT:

Bed sediments in a three-mile reach of the Ottawa River are largely composed of sand-sized mineral grains and wood chips, with

finer, organic-rich sediments segregated towards channel margins. The amount of leachable mercury in the bed sediment correlated strongly with leachable iron content, and less well with mean ($\phi$) grain size and organic content. These results are best explained by surface adsorption of mercury on grain coatings of hydrated iron oxide and complexing with organic particles. Mercury concentration of hydrated iron oxide and complexing with organic particles. Mercury concentration therefore increases with decreasing grain size and/or increasing content of wood chips.

Bedload transport occurs mainly by dune migration; the rate was about 4 x $10^5$ kg/day in early June, 1974, yielding a mercury discharge of about 10 g/day in bed sediment. The main sources of pollution were controlled in 1971, and mercury levelsare now declining about 66% per year in the coarser mid-channel sediment, and about 40% annually in the finer channel-margin sediments. The differential rate is thought to be due to the greater influence of mechanical transport in areas with coarser sediment, whereas chemical desorption is the principal means of mercury loss from finer deposits.

DATA:

Secondary Source; refer to Waslenchuk (1975).

319. SAHABANDU, A.
1981: Planning for Erosion Control and Bank Stabilization in the River Valleys of Metropolitan Toronto; In: Erosion and Sedimentation in Ontario, a Time for Action some Papers from the Winter, Summer, and Fall Meetings of the Ontario Chapter, Soil Conservation Society of America, Erosion and Sedimentation, Urban Erosion and Sedimentation, Planning for Prevention, June 17, 1977, Humber College, Toronto, p. 41-50.

ABSTRACT:

The purpose of this paper is to outline a case study in planning for erosion control and bank stabilization in the river valleys of metropolitan Toronto. Man-made erosion problems rather than natural forms of erosion existent in metro Toronto are discussed. These man-made problems include inadequate setbacks, fill problems, inadequate storm water management, destruction of vegetation and poor or inadequate planning and design of structures such as retaining walls. These man-made problems indicate a lack of public awareness regarding potential problems associated with the use of the valley system resource. The remedial work project, which is funded on a 50:50 basis between the province of Ontario and the municipality of metropolitan Toronto is described. The project has three basic components which are major remedial work, minor remedial work and a revegetation programme. As the project is strictly a reaction to an immediate need, and does little to control the causes, there is

a need for long-term planning over large areas with consideration of the whole watershed system. The Metropolitan Toronto and Region Conservation Authority compiled the document "Conservation aspects of Official Plans". Part of the document is summarized in this paper. When it becomes incorporated in the municipal official plan it will play a major role in planning for control of erosion and sedimentation. Sedimentation in the valley system of metro Toronto is described, with the main source being from scour action resulting from the steep river gradients, development sites and storm sewers. Any deposition of sediment is mostly at the mouth of the river where the Toronto Harbour Commission, Metro Parks and the Authority's waterfront section strive to check the problem. In conclusion, it is noted that is is important to correct erosion problems at early stages and to have more funding in order to catch up with and stay ahead of existing problems. It is necessary to have adequate legislation or bylaws to prevent and control future problems. If these are in effect, costly remedial work may not be a necessity in the future.

DATA:

Primary Source.

320. SAIN, P., ROBINSON, J.B., STAMMERS, W.N., KAUSHIK, N.K. and WHITELEY, H.R. 1977: A Laboratory Study on the Role of Stream Sediment in Nitrogen Loss from Water; Journal of Environmental Quality, Vol. 6, No. 3, p. 274-278.

ABSTRACT:

Laboratory experiments were conducted on samples of sediment collected from a stream having an appreciable input of nitrate at its source. Earlier work had shown that the water lost much of the nitrate as it moved downstream, presumably by denitrification. Columns of sediment were reconstituted in plexiglass tubes, overlain with water containing nitrate, and incubated at 10, 15, or 22C. The water was aerated with a helium-oxygen mixture. Nitrate concentration decreased rapidly but the rate varied with temperature and depth of sediment. At 22C, in water overlying 10-cm columns of sediments, over 90% of the nitrate was removed in 3 weeks from a solution originally containing 10 mg/liter nitrate-N. Nitrate disappeared less rapidly at lower temperatures and when sediment columns were <5 cm deep. It was concluded that in columns <5 cm deep and at low temperatures nitrate diffused to the bottom of the columns, while columns 5 cm deep or more were effectively of infinite depth. Because of the interdependence of diffusion from the liquid phase into the sediment and denitrification, it is not possible to infer kinetics of denitrification in these experiments. It appeared that denitrification in these columns proceeded at a rate compatible with observations made previously in the stream from which the sediment originated.

DATA:

Primary Source.

321. SAYEED, H.A.
1975: Laboratory Investigations of Mercury Kinetics in the Ottawa River Bed Sediments; Unpublished M. Sc. Thesis, Department of Civil Engineering, University of Ottawa, 157 p.

ABSTRACT:

The Ottawa River project is an ongoing multidisciplinary research programme in which a group of engineers, geologists and scientists from the University of Ottawa and National Research Council Laboratories of Canada, are attempting to produce predictive ecological models for part of the Ottawa River system. The river is acting as a receiving body for pollutants from various industries and cities located at points along its shores.

A significant amount of mercury, which is one of the major pollutants, is retained in the bed sediments and, with time, this ongoing process has resulted in a contamination problem in the system.

A 4.88 km-long stretch of the river, (1.6 km downstream from the city of Ottawa), was chosen as the study section along which a comprehensive programme of field studies are being performed. As a part of the Ottawa River project this laboratory study was carried out to investigate the relationships between bed sediment characteristics and the distribution and movement of mercury associated with bed load movements.

It has been established (21) that the bulk of mercury contamination in the river resides in the bed sediments. The river bottom consists largely of medium fine sands, in the central (main channel), compacted clay, on the Ontario shore, and agglomerated organic mixtures, largely wood fibres, wood chips, barks and fine sands near the Quebec shore.

Cation exchange capacities of the components of the bed sediments have been determined to gain information about the proportion of mercury which may be carried absorbed on stream sediments instead of in solution. Laboratory studies of mercury distribution among various components of the sediment mass lead to predictions of mercury concentrations which closely match observed field values. Sediment components of high organic content, more particularly the wood chips and fines (particles of diameter between 0.45 μm and 38 μm) have associated with them 50 to 100 times the amount of mercury associated with sand particles.

The results emphasize the importance of particle size and material type analysis in studies of pollutant transport by bed sediment movements.

A 9.15 m long laboratory model (flume) was used to study mercury transport by bed sediment movements. Two types of Ottawa River bed sediments, called sand and "woodchip"[1] sediments, were

studied. Known amounts of bed sediments were contaminated by adding mercuric chloride labelled with radioactive mercury-203 and were buried in the test section of the study flume. Velocity of mercury transport associated with bed sediments was determined and found to be a function of type of bed sediments as well as mean water velocity.

Mass balance of mercury was also estimated and it was found that over 80 percent of mercury originally associated with bed sediments was transported attached to bed sediment particles being moved downstream. Desorption of mercury from bed sediments to the water phase was comparatively low although suspended-load contained a significant portion of mercury when bed sediment transport was vigorous. The values of flow parameters (velocities, boundary shear stresses) at the incipient movement of the bed sediment particles were also determined for the two types of sediments mentioned above.

DATA:

Primary Source.

322. SCHINDLER, D.W.
1976: Biogeochemical Evolution of Phosphorus Limitation in nutrient-Enriched lakes of the Precambrian Schief; In: Environmental Biogeochemistry, Vol. 2, Metals Transfer and Ecological Mass Balances, j.O. Nriagu, editor, Ann Arbor Science, p. 647-664.

ABSTRACT:

This paper examines the factors affecting the regeneration of nutrients from sediments in the Experimental Lakes Area Lakes.

DATA:

Primary Source.

323. SCHINDLER, D.W., HESSLEIN, R. and KIPPHUT, G.
1976: Interactions Between Sediments and Overlying Waters in an Experimentally Eutrophied Precambrian Shield Lake; In: Interactions Between Sediments and Fresh Water, H.L. Golterman, editor, p. 235-243.

ABSTRACT:

Several recently-developed methods were used to study the role of sediments in the nutrient economy of a small Precambrian Shield lake which has been artificially fertilized for several years with phosphorus and nitrogen. Measurement include gross and net nutrient fluxes, estimated by employing a combination of mass-balance techniques, whole-lake additions of isotopic tracers and recent dating techniques.

Input-output mass balances revealed that 81 and 61 percent of phosphorus and nitrogen, respectively, added over 6 years were deposited in sediments, while 1 and 11 percent appeared in the water column. Direct measurements of phosphorus and nitrogen in sediment cores agreed well with mass-balance calculations of sedimentation.

Sediment "peepers" (racks of small vials spaced at 1 cm intervals, filled with distilled water and covered with dialysis membrane) were inserted into sediments, and left to equilibrate. Analysis of the contents of these allowed rapid estimation of nutrient concentrations in pore waters, while eliminating the problems associated with extraction of pore water under anoxic conditions. Coefficients of diffusion were estimated simultaneously by tagging water of the entire lake with tritium and measuring its rate of penetration into pore waters. Values so obtained averaged $2 \times 10^{-5}$ $cm^2$/second. Coupled with observed nutrient gradients in pore waters, the following conclusions were reached:

Pore water gradients of phosphorus were absent or weak, and concentrations were low. Sediments did not release significant amounts of phosphorus to overlying waters under either oxic or anoxic conditions. This result was confirmed by mass-balance results. Almost all of the phosphorus in sediments was bound to the particulate fraction.

Steep gradients of $NH_4$-N in pore waters indicated that over 50% of summer epilimnetic total nitrogen could potentially be replaced from littoral sediments each day. On the other hand, nutrients released from the hypolimnion or hypolimnion sediments were not important in the maintenance of epilimnetic algal blooms in midsummer, because vertical eddy diffusion in the region of the thermocline was less than $10^{-4}$ $cm^2$/sec. Studies of horizontal and vertical diffusion in the water column revealed that horizontal, rather than vertical water movements were chiefly responsible for the resulting distribution of nitrogen and carbon in the water column.

Lead-210 and cesium-137 from fallout, artificially added radium-226, and the added nutrients were used to measure recent sedimentation rates and mixing depths. The sedimentation rate averaged 1.0 mm/yr. Recently-deposited material was found mixed to a depth of 5 to 10 cm. The possible importance of this mixing as a "buffer" delaying the alteration of lake trophic conditions when external sources of nutrients are changed is discussed. The half-time for establishing a new equilibrium between the sediment mixed layer and overlying water is estimated to be 35 years.

DATA:

Primary Source.

324. SCHINDLER, D.W., HESSLEIN, R.H., WAGEMANN, R. and BROEKER, W.S.
1980: Effects of Acidification on Mobilization of Heavy Metals and Radionuclides from the Sediments of a Freshwater Lake; Canadian Journal of Fisheries and Aquatic Sciences, Vol. 37, No. 3, p. 373-377.

ABSTRACT:

Large (10m) diameter enclosures were sealed to the sediments in 2-2.5 m of water in Lake 223. Two tubes were held at control pH (6.7-6.8), one was lowered to pH 5.7 and one to pH 5.1, using $H_2SO_4$. Aluminium, manganese, zinc, and iron were released from lake sediments at pH5 and 6. Concentrations of zinc in the overlying water column exceeded 300 $\mu g l L^{-1}$. Radioisotopes of several heavy metals added to the water of the enclosure showed the following: all metals were removed from the water at log-linear rates, with half-times of 5-25d. Acidification caused several metals to become more soluble, including Fe-59, Co-60, Mn-54, and Zn-65. Solubility of V-48 and Hg-203 decreased with increasing acidity. Acidification also slowed the loss to sediments of Mn-54 and Zn-65. Losses of Ba-133, Se-75, Cs-134, and V-48 were more rapid under acid conditions. The fractions of any isotope retained by a 0.45 µm filter, activated charcoal and mixed-bed ion exchange resin remained constant throughout the experiment at any given pH.

DATA:

Primary Source.

325. SEMKIN, R.G.
1975: A Limnological Study of Sudbury Area Lakes; Unpublished M. Sc. Thesis, Department of Geology, McMaster University, Hamilton, 248 p.

ABSTRACT:

Sixty-five lakes in the Sudbury-Temagami area of northern Ontario were investigated in the summer of 1973. Physical, chemical and biological parameters were measured in the lake waters and in the lake bottom sediments. All the lakes were characterized as oligotrophic in nature which is typical of most inland waters in the Canadian Precambrian Shield.

Chemical data from atmospheric precipitation in the study area revealed a substantial deposition of heavy metals and sulphate, the source of which was the mining/smelting industry at Sudbury. That these potentially toxic materials were entering the lentic systems was evidenced by: 1) the acidic conditions of many lakes, particularly those lakes whose geological basins lacked carbonate minerals to buffer acid loadings; 2) the contours of heavy metals (Ni, Cu, Zn, Pb, Cd, Fe) in lake waters and in lake sediments that

showed increasing concentration gradients toward Sudbury, and 3) the parallel trend of Ni: Cu, etc., metal ratios in atmospheric precipitation and in lake sediments, suggesting a common origin for such metals.

Lake sediment material, generally a silty clay or clayey silt, was observed to be rich in organic matter (high organic C, high total nitrogen). High C : N sediment ratios reflected the slow sedimentation rate in the study lakes and, therefore, the limited levels of primary productivity in the lake waters. The total Fe content and redox status of the sediments was important in determining the amount of sediment phosphorus that would be available to the overlying waters.

DATA:

Primary Source.

326. SEMKIN, R.G. and KRAMER, J.R.
1976: Sediment Geochemistry of Sudbury Area Lakes; Canadian Mineralogist, Vol. 14, No. 1, p. 73-90.

ABSTRACT:

Sixty-five lake-sediment samples were collected from the Sudbury-Temagami area (46°15' - 47°30'N; 79°30' - 81°30'W) during the summer of 1973. Sediment samples frozen in the field were freeze-dried and ground to 200 mesh for all chemical determinations. Sediment analyses included heavy metals (Ni, Cu, Zn, Pb, Cd, Fe, Mn), organic carbon, total Kjeldahl nitrogen, acid-extractable phosphorus, and particle-size distribution. Increasing concentration gradients towards Sudbury were observed for the heavy metals in the surface sediments, particularly Ni and Cu. Additional evidence for a point source of heavy metals at Sudbury was observed in the parallel behaviour of Ni:Cu and Cu:Zn ratios in both sediment and in atmospheric precipitation. The sediment material was determined to be a silty clay with a relatively high organic content, which is essentially typical of the surface sediments found in oligotrophic lakes. Acid-extractable sediment phosphorus formed approximately 50% of the total phosphorus and displayed a marked relationship to the sediment Fe concentration.

DATA:

Secondary Source; refer to Semkin (1975).

327. SHAMI, R.J.
1981: Characterization of Organic Bottom Sediments in Some Low-Order Southern Ontario Streams; Unpublished M.Sc. Thesis, Department of Land Resource Science, University of Guelph, 237 p.

ABSTRACT:

A fraction of the total particulate load in streams is that organic material which moves by saltating along the bed during periods of relatively low flow. At certain times of the year, the stream bed may be covered with this material. It is most obvious in upstream reaches and during low flow periods is the active interface separating the stream bed and the water column. This material is highly organic and represents a large amount of stored organic carbon. It is referred to in the present study as "organic bedload" (OBL). The objectives of this study were first, to characterize OBL collected from some small, southern Ontario streams in terms of its movement and its physical; chemical and biological properties and second, to examine OBL as a site for physical and microbial processes involving dissolved materials in stream transport.

OLB settled into sampling trays placed in the stream in areas where water velocity was reduced, e.g. along margins or in pool zones. Its rate of deposition generally decreased with distance downstream, depositing in upstream reaches at rates >180 g dry wt$\cdot m^{-2} \cdot day^{-1}$ while downstream this fell to <100 g dry wt$\cdot m^{-2} \cdot day^{-1}$. Organic content also declined with distance downstream, falling in the Speed River from an average 38% in headwater reaches to 17% further downstream.

OBL was characterized using physical parameters such as cation exchange capacity (CEC), organic C and N content of various size classes, and size distribution. At an upstream Eramosa R. site, the CEC associated with OBL was found to be very high, measuring 120 me$\cdot$100 g dry $wt^{-1}$ and was positively correlated with both particle size and organic content. CEC values ranged between 80 and 206 me$\cdot$100 $g^{-1}$ for increasing size classes <1 mm. The CEC of the organic fraction of OBL here calculated from regression analysis to be 296 me$\cdot$100 g $OM^{-1}$, represented <80% of the total CEC.

Size distribution analyses indicated that most particles were <106 µm in diameter and distribution was found to shift towards smaller size classes with increasing distance downstream in the Speed R. Organic matter content was positively related to particle size.

Biological activity was assessed by scanning electron microscopy (SEM) and by studies of $O_2$ uptake by particle size as measured in a Warburg apparatus. SEM images indicated the presence of a rich diatom community supported by amorphous aggregates of material. Woody skeletons were sometimes seen. Rates of $O_2$ uptake generally declined very slowly with time and gave good approximations of straight lines when plotted semilogarithmically. Initial rates per gram were positively related to organic matter content and particle size, with the constant exception of material <45 µm. This fraction initially

respired at rates far exceeding other classes, but after two weeks, its rate had dropped sharply and all classes respired at rates closely related to their organic content. Respiration experiments indicated that despite its high organic content, OBL was normally unavailable for rapid microbial decomposition. However, processes which disrupted the integrity of OBL particles (e.g. grinding, air drying) elevated short-term and depressed long-term respiration rates for all size classes relative to controls. Presumably, these treatments made available a portion of the organic matter which was previously physically inaccessible.

Evidence gained using a laboratory model, indicated OBL was responsible for the removal of glucose and glutamate from solution. Appreciable amounts disappeared even at 29°C. Rates of substrate uptake were positively related to the initial substrate concentration and the degree of contact between OBL and the water column. Evidence suggested that uptake at 2°C was mediated to a large extent by physical processes. The high CEC may be the basis for a physical effect of OBL on dissolved materials in stream transport.

328. SHANNON, E.E. and VACHON, D.T.
1973: The Welland Canal Water Quality Control Experiments (Phase I); Report, Environment Canada, Environmental Protection Service, Water Pollution Control Directorate, Technology Development Report EPS 4-WP-73-1, 43 p.

ABSTRACT:

The existing (fourth) Welland Canal will be replaced by the new (fifth) Welland Canal in the spring of 1973. In order to evaluate water quality control alternatives for the abandoned canal, the St. Lawrence Seaway Authority and the Environmental Protection Service initiated a demonstration study in May 1972, on four basins located in a stretch of the third Welland Canal. One basin was treated with aluminum sulphate (alum) at a dosage of 5 mg/l as Al; another basin was maintained as a controlled flow-through situation (4-day retention time); a third basin was treated with copper sulphate at a dosage of 1 mg/l and the fourth basin was used as a control.

The biological, chemical and physical characteristics of the basins were monitored on a weekly basis from May to September 1972. Specific water quality comparisons between basins were made with respect to total phosphorus, chlorophyll *a*, primary production, turbidity, sediment characteristics and heavy metals. Although nuisance conditions (algal blooms) did not develop in any of the experimental basins, there were significant inter-basin water quality differences.

It was concluded that alum treatment was a feasible method of maintaining acceptable water quality in the Welland Canal. The

alum treatment appeared to be at least as effective as the controlled flow-through situation in maintaining an acceptable level of water quality. The cost of the alum treatment was estimated at $121/acre of water surface for a single treatment.

The study is continuing to assess the long-term effects of alum treatment.

DATA:

Primary Source.

329. SHARMA, T.C.
1977: A Discrete Dynamic Model of Watershed Sediment Yield; Unpublished Ph.D. Thesis, School of Engineering, University of Guelph, 137 p.

ABSTRACT:

The watershed fluvial systems is hypothesized as a lumped linear system with runoff rate (log transformed) as input and sediment yield rate (log transformed) as output on a discrete time basis. The effects of errors in sampling, data reduction, discretizing etc. of input and output sequences are simulated by another linear system to which input is a white noise. The Box and Jenkins ARIMA schemes have been utilized to model the error component.

A parsimonious linear input-output model is shown to be possible in terms of nonstationary runoff and sediment yield sequences on monthly and daily basis. Further, a first order dynamic model of monthly sediment yields. The characteristics of the noise (error) component correspond with a white noise sequence contributing 10 to 19 percent of the variance in the monthly sediment yield sequence. A linear linkage model between monthly runoff and sediment yield explains 81 to 90 percent variance.

A second order dynamic model with seven parameters adequately models the daily sediment yields. The noise component is approximated by a white noise sequence. Nearly 3 to 5 percent variance in the daily sediment yield can be attributed to this noise component. The remaining 95 to 97 percent of the variance is explained by the input-output model.

Unit step and frequency response functions are shown to provide useful indices for interpretation of the fluvial characteristics of the watersheds in Southern Ontario, Canada.

DATA:

Secondary Source; refer to Water Survey of Canada data.

330. SHARMA, T.C. and DICKINSON, W.T.
1979: Discrete Dynamic Model of Watershed Sediment Yield; Journal of the Hydraulics Division, American Society of Civil Engineering, Vol. 105, No. HY5, Proceedings Paper 14592, p. 555-571.

ABSTRACT:

The watershed fluvial system is hypothesized as a lumped system with runoff rate (log-transformed) as input and sediment yield rate (log-transformed) as output on a discrete time basis. The effects of errors in sampling, data reduction, discretizing etc. of input and output sequences are simulated by another linear system to which input is a white noise. A first order dynamic model with five parameters is demonstrated to provide an adequate model of monthly runoff-sediment yield process. A second order dynamic model with seven parameters adequately models the daily runoff sediment yield process. The noise component was found to be a white noise sequence in both cases, explaining 10 to 19 % of the variance in the monthly sediment yields and 3% to 5% of the variance in the daily sediment yields. A linear linkage model explains 81% to 90% of the variance in the monthly sediment yields and 95% to 97% of the variance in daily sediment yields.

DATA:

Secondary Source; refer to Water Survey of Canada data.

331. SHARMA, T.C. and DICKINSON, W.T.
1979: Unit Step and Frequency Response Functions Applied to the Watershed Fluvial System; Journal of Hydrology, Vol. 40, No. 3-4, p. 323-335.

ABSTRACT:

Unit step response and frequency response are shown to provide useful information to model and understand the watershed runoff-sediment yield process. One of the applications of the unit step response is to rank watersheds for their sediment production potentials. The frequency response function is used to indicate the memory content of the watershed runoff-sediment yield system.

DATA:

Secondary Source; refer to Water Survey of Canada data.

332. SHARMA, T.C. and DICKINSON, W.T.
1980: System Model of Daily Sediment Yield; Water Resources Research, Vol. 16, No. 3, p. 501-506.

ABSTRACT:

Input-output systems concepts have been applied to the modeling of daily runoff-sediment yield of the Thames River in southern

Ontario, Canada. Spectral and correlation techniques have been used to construct a parsimonious model of daily sediment yields. It is shown that a linear discrete dynamic model is possible in terms of log-transformed daily runoff and sediment yield sequences. The fluvial system of the Thames River watershed exhibits a weak memory on a daily basis, and the noise component corrupting the watershed fluvial system resembles a white noise process.

DATA:

Secondary Source; refer to Water Survey of Canada data.

333. SHARMA, T.C., HINES, W.G.S. and DICKINSON, W.T.
1979: Input-Output Model for Runoff-Sediment Yield Processes; Journal of Hydrology, Vol. 40, No. 3-4, p. 299-322.

ABSTRACT:

Runoff (log-transformed) and sediment yield (log-transformed) sequences on a monthly or daily basis can be regarded as input and output for the watershed fluvial system. These sequences are nonstationary in general in different hydrological environments. Frequency and time domain analyses have shown that a parsimonious model can be built directly in terms of these nonstationary input-output sequences on a monthly and daily basis. A first-order dynamic model was found adequate to model the monthly runoff-sediment yield process; a second-order model adequately modeled the daily runoff-sediment yield process. The noise component in both cases possessed the characteristics of a white-noise sequence.

DATA:

Secondary Source; refer to Water Survey of Canada data.

334. SHERMAN, K.
1981: Water Quality of Talbot Lake in Relation to Shoreline Development, Laxton Township, Victoria County; Report, Ontario Ministry of the Environment, Technical Support Section, Central Region, 22 p.

ABSTRACT:

A report is presented of a survey conducted on Talbot lake in 1980 to outline the existing water quality status and to assess the effects of proposed additional development on the water quality status of th lake. The study area is described and the survey procedures are outlined. All results of physical and chemical samples taken are presented in an appendix. A discussion of the survey results presents pertinent data on physical characteristics of the lake, including information on its basic water chemistry,

dissolved oxygen, nutrients, phytoplankton, benthic invertebrates and aquatic plants. Various sources showed that only 9% came from existing shoreline development. Concerns about the direct effect of cottage development on water quality of Talbot Lake are overshadowed by the indirect physical influence of associated recreational uses of the lake. The lake water quality is considered sensitive to mechanical disturbances of lake sediment through such uses as power boats and hence, some restriction of recreational uses of Talbot Lake will occur.

DATA:

Primary Source.

335. SHILTS, W.W. and FARREL, L.E.
1982: Subbottom Profiling of Canadian Shield Lakes-Implications for Interpreting Effects of Acid Rain; Turkey Lakes Watershed Unpublished Report No. 82-13, 13 p. Also: Current Research, Part B, Geological Survey of Canada, Paper 82-1B, p. 209-221, 1982.

ABSTRACT:

Distribution and physical characteristics of both modern and glacial sediments are reported for the material in the bottom of 4 shield lakes including Turkey and Little Turkey Lakes. Three to five metres of gyttja overlies bedrock and glacial sediments in all but the steepest part of the lake basins. Anomalously high carbonate content in the drift adjacent to the lakes is reported.

DATA:

Primary Source.

336. SMITH, B.D.
1972: Dominant Physical Parameters of Point Bar Sedimentation With Reference to a Selected Portion of the Nith River; Unpublished B.Sc. Thesis, Department of Geography, University of Waterloo, 204 p.

ABSTRACT:

Analysis of the relationships between meandering and Point bar sedimentation and the parameters that influence this relationship, a problem facing fluvial geomorphologists and sedimentologists for years, had been attempted within the Nith river, a tributary within the Grand River watershed of south-western Ontario.

Slope, sediment (suspended, bedload), depth, velocity-discharge, and channel geometry were analyzed within a selected portion of the Nith river, a predominantly lower flow regime, meandering river traversing a young Pleistocene valley composed of outwash

gravels and sands with a mean discharge during the study period of 1.5 c.m.s. (45.1 c.f.s.). The reach was studied from May to September of 1971. Instrumentation utilized included a 720 Hiroi Acoustic current meter, a U.S. DH-48 depth integrating suspended-sediment wading hand sampler, a 10 cm. interval calibrated depth rod and a Bouma Box sediment sampler.

Analysis of the data, which included a period of bankfull discharge, supports the contention, that the combination of the analyzed physical parameters influenced the development of Point bars and meandering. Slope is the most influential parameter. The period of bankfull discharge resulted in channel configuration variations, associated with increased rates of (1) concave bank erosion; (2) point bar accretion and (3) sediment transport. An approximate correlation was demonstrated between the present fluvial and paleo Point bar environments. The characteristic coarse texture of Point bar and channel sediment sediment was observed to be a function of the sediment source of outwash gravels and sands. The operation of the bar head and pool currents during bankfull discharge contributed to Point bar development and meander migration. Human interaction was observed to influence sedimentation and fluvial processes through bridge construction and mis-management of agricultural practices. Present Point bar development is restricted to bar platforms where accretion was observed to be dependent upon bankfull discharge. Bar platform sedimentation was found to consist of bedload transport through migration of gravel bars and coalescence of conical gravel mounds. Thalwegs and lines of maximum velocity were deflected towards the concave bank as a consequence of bar platform lateral extensions. A laboratory flume analysis of the initiation of meandering and Point bar development exhibited remarkable similarity to field conditions and parameter inter-relationships analyzed.

DATA:

Primary Source.

337. SMITH, B.D.
1976: Sediment Surveys in the Ontario District; Report, Environment Canada, Inland Waters Directorate, Water Survey of Canada, Ontario Region. 16 p.

ABSTRACT:

This paper presents an outline of the sediment survey program in the Ontario District from its inception in 1965 to present day activities. Attention is directed towards the Survey's history, and its future requirements to facilitate the growing need for sediment data. Recommendations are made on new techniques and principles, expansion or discontinuation of stations and on analytical and daily methods involved in the Sediment Survey program.

DATA:

Secondary Source; refer to Water Survey of Canada data.

338. SMITH, B.D.
1980: Filtration of Suspended Sediment Samples Using Various Filter Combinations; Report, Environment Canada, Inland Waters Directorate, Water Resources Branch, Ontario Region, 27 p.

ABSTRACT:

In an effort to eliminate the use of asbestos, as a filtering agent in sediment sample analyses, the Water Survey of Canada initiated the following experiment to be conducted by the Guelph Laboratory. Various types of filters, prefilters and absorbent pads were selected to be used in the test as a comparison to the standard 934 AH filter with asbestos mat used by the Water Survey of Canada. Material was collected from various streams in Ontario and the Western and Northern Regions. Various sample weights of material were combined with a 500cc. volume of water (distilled or native) to produce different concentration ranges. The pre-mixed samples of known concentrations were passed through the filter combinations and the net loss of each sample was computed. The results were tabulated and suggested filters and prefilters were recommended as replacement for the present method used in our laboratories.

DATA:

Secondary Source; refer to Water Survey of Canada data.

339. SMITH, B.D.
1982: Ontario Region Sediment Laboratory - A Study of Analysis Costs; Report, Environment Canada, Inland Waters Directorate, Water Resources Branch, Ontario Region, 11 p.

ABSTRACT:

This paper deals with the determination of sediment laboratory analysis costs. This was done with the intention of providing a guideline for allocating laboratory funds and as a basis for predicting expenditure in environmental impact studies or general hydrometric sediment studies.

DATA:

Secondary Source; refer to Water Survey of Canada data.

340. SMITH, B.D.
1982: Oshawa Second Marsh Baseline Study, Summary Report, Environment Canada, Inland Waters Directorate, Water Resources Branch, Ontario Region, 38 p.

ABSTRACT:

Sediment loading from Harmony Creek is identified as the major contributor to the sedimentation of Oshawa Second Marsh. The

suspended sediment load accounts for 93% of the total sediment load of Harmony Creek. Sediment sources in the upper watershed of Harmony Creek are responsible for the sediments in Harmony Creek while the hydraulic parameters of Harmony Creek are affected by urbanization and thus provide the mechanisms for transport of these sediments. The majority of sands and course silts are deposited below Harmony and Farewell Creek gauging stations and in the upper portions of Oshawa Second Marsh. Fine silts and clays are transported through the barrier beach outlet into Lake Ontario. The barrier beach outlet determines the degree of sedimentation within terms of total sediment loadings from the Harmony Creek watershed to Oshawa Second Marsh.

DATA:

Secondary Source; refer to Water Survey of Canada data.

341. SMITH, B.D.
1983: North Magnetawan River above Pickeral Lake. Sediment Study Review; Internal Report, Environment Canada, Inland Waters Directorate, Water Resources Branch, Ontario Region, 27 p.

ABSTRACT:

The purpose of this study was to determine if the suspended sediment loads at this station justified the upgrading of the gauge shelter. Results showed that discharges and concentration at this site are low. Therefore the station was discontinued from the sediment network due to low loadings.

DATA:

Secondary Source; refer to Water Survey of Canada data.

342. SMITH, B.D.
1983: Ontario Region Miscellaneous Sediment Station Network Proposal; Internal Report, Environment Canada, Inland Waters Directorate, Water Resources Branch, Ontario Region, 62 p.

ABSTRACT:

The need for better sample coverage of drainage basins and a network evaluation of existing sediment stations has led to this proposal for a new miscellaneous sediment station network. This network would (1) supplement the need for increased sample coverage, (2) serve as base data from which new continuous sediment stations could be proposed and (3) complement environmental assessment and baseline studies.

All proposed miscellaneous fulltime continuous, seasonal and miscellaneous stations were classified according to the 1979 task force on Sediment Surveys and the Federal/Provincial Hydrometric Cost share Agreement.

The present sediment network was reviewed and proposals for the fiscal years 1983-84, 1984-855 and 1985-86 are included in Appendix A. Historical and current sediment data was reviewed and sediment yields were calculated. These are found in Appendix B and served as a basis from which areas lacking in sediment data were identified. These areas were then designated as having proposed miscellaneous sediment stations.

Costing for this proposed miscellaneous network was sub-divided based on the cost share agreement and included laboratory, capital purchases and operation and maintenance costs.

DATA:

Secondary Source; refer to Water Survey of Canada data.

343. SMITH, B.D.
1985: Big Otter Creek near Calton, Sampler Comparison Study; Internal Report, Environment Canada, Inland Waters Directorate, Water Resources Branch, Ontario Region, 55 p.

ABSTRACT:

In 1984, a joint project was undertaken between the Ontario Region, Sediment Section and the Sediment Survey Section at Headquarters. The project was initiated to test the modified PWS automatic sediment sampler and its sampling capabilities when compared to depth and point integrated sampling. The latter two modes of sampling were undertaken using a DH59 and P73 suspended sediment sampler respectively. Samplers were used from the bridge at exactly the same locations as the PWS sampling orifice.

The hydrometric station at Big Otter Creek near Calton was selected because of the large quantity of suspended sediment and involves a large array of particle sizes, especially those in the sand size classification. Sampling was undertaken in lake March to early April 1985 and involved two separate storm events, each with its own distinctive sediment concentration and transport capacities.

Analysis of the data was undertaken by the Ontario and Regina laboratories. Samples were analyzed by either filtration, evaporation slit analysis to determine the percentage sands in selected samples.

DATA:

Secondary Source; refer to Water Survey of Canada data.

344. SMITH, B.D.
1985: Individual Sediment Sample Repeatability Study; Internal Report, Environment Canada, Inland Waters Directorate, Water Resources Branch, Ontario Region, 35 p.

ABSTRACT:

In the fall of 1982, a joint project was proposed with Sediment Headquarters. This project was considered to be an important part of the Sediment Sampling Quality Control Program.

A number of continuous sediment stations in the Ontario Region were selected for this study at which technician and gauge attendant samples would be analyzed separately to determine variability between the A and B sample.

Results show that the correlation between the two samples was very good except for one. Excellent correlations were also observed for sand transported regimes even at high concentrations and discharge levels.

DATA:

Secondary Source; refer to Water Survey of Canada data.

345. SMITH, B.D.
1985: Automatic PS82 Suspended Sediment Sampler. Thames River at Innerkip. A Case Study; Report, Environment Canada, Inland Waters Directorate, Water Resoures Branch, Ontario Region, 47 p.

ABSTRACT:

A new light weight portable automatic suspended sampler was installed and tested in the upper part of the Thames River watershed. The period of record was from September 1984 to October 1985. The PS82 sampler was installed along with a depth proportional sampling intake.

A number of storm events were intensely sampled to determine comparative results to the single vertical depth integrated method of sampling.

Results of the study showed three different sample populations due to various environmental reasons. Results from these three different populations show that the orifice setting on the depth proportional intake is critical to ideal comparative results. A fixed orifice setting provided the best results in sampling modes.

Site selection, orifice placement, and PS82 operation schedule all were determined to be controlling variables in a successful analysis of this automatic sampler.

DATA:

Secondary Source; refer to Water Survey of Canada data.

346. SMITH, H.J.
1973: Accelerated Sedimentation in the Ganaraska Watershed: A Case Study; Unpublished B.A. Thesis, Department of Geography, York University, Toronto, 106 p.

ABSTRACT:

Studies of man-induced erosion rarely include information regarding the disposition of eroded material. In the Ganaraska Watershed there has been a serious problem of soil erosion for over fifty years. Two small watersheds, tributary to the Ganaraska River, were investigated as to the depth of culturally accelerated sedimentation of the floodplains. The depths of modern fill in these valley range from less than one foot to over six feet. Sites of serious erosion were determined and mapped from air photographs taken in 1927, 1954 and 1964. Although a number of factors were investigated, the most important factor which influences the depth of modern sediment appears to be the proximity of erosion sites and the relative amounts of material derived from these sites.

DATA:

Primary Source.

347. SMITH, V.E., SPURR, J.M., FILKINS, J.C. and JONES, J.J.
1985: Organochlorine Contaminants of Wintering Ducks Foraging on Detroit River Sediments; Journal of Great Lakes Research, Vol. 11, No. 3, p. 231-246.

ABSTRACT:

Organochlorine analysis was performed on carcasses of 13 diving ducks from a 1981 wintering population that foraged on contaminated sediments in the lower Detroit River. Mean total PCB concentrations were 10 mg/kg for seven lesser scaups (Aythya affinis), 11 mg/kg for three greater scaups (A. marila), and 7.6 mg/kg for three goldeneyes (Bucephala clangula). Highest mean levels of other residues were measured for hexachlorobenzene (1.7 mg/kg) in goldeneyes, and transnonchlor (0.33 mg/kg) and 4,4'-DDE (1.3 mg/kg) in greater scaup. Quantitative analysis of 72 PCB congeners also was applied to water, seston, sediment, benthic oligochaetes, and carp from the same site. Principal congeners in most of the samples included some of the more toxic and persistent PCBs. Results of multivariate analysis indicated that ratios of more conservative to less conservative PCBs did not vary significantly among ducks ($\alpha$ - .05), but differed from those in carp, oligochaetes, and sediment. For the February through March period of fat mobilization, concentrations of total PCB in lipid were inversely correlated with percent lipid (r - 0.76) in ducks. The percentage of conservative PCBs increased slightly. The distribution and partitioning of organochlorines, including toxic

PCB congeners, varied considerably within this water column-sediment-fauna ecosystem. Estimates of toxic exposure based on total PCB values may be unreliable.

DATA:

Primary Source.

348. SMOL, J.P., BROWN, S.R. and McNEELY, R.N.
1983: Cultural Disturbances, and Trophic History of a Small Meromictic Lake from Central Canada; Hydrobiologia, Vol. 103, p. 125-130.

ABSTRACT:

The recent history of Little Round Lake, a small meromictic lake in southeastern Ontario, is considered. Pollen analyses were used to identify past changes in terrestrial vegetation, whilst limnological conditions were interpreted on the basis of diatom and chrysophyte microfossils. Contemporaneous with the arrival of European settlers (ca. A.D. 1850), the predisturbance assemblage of oligotrophic Cyclotella diatoms was replaced by Synedra spp., which then succeeded to a eutrophic flora dominated by Stephanodiscus hantzschii. Meanwhile, synuracean algae were almost completely excluded. Over the last 30 years, the algal microfossils indicate that the lake underwent a marked return to oligotrophy. Evidence is presented which suggests that this shift was related to the cultural enhancement of meromixis by the seepage ofroad salt.

DATA:

Secondary Source; Refer to McNeely (1975).

349. SOLOMON, S.I. and GUPTA, S.K.
1977: Distributed Numerical Model for Estimating Runoff and Sediment Discharge of Ungaged Rivers: 2. Model Development; Water Resources Research, Vol. 13, No. 3, p. 619-629.

ABSTRACT:

This is the second of a series of three papers describing the methodology of development of a distributed model for estimating runoff and sediment discharge of ungaged rivers. This paper presents the design of the model which permits its application to watersheds of any size and the obtaining of runoff and sediment time series at any point of the river basin which is being modeled. The model requires inputs which are usually available for most areas and/or can easily be synthesized from secondary sources or by transposition. The model was designed with the aim of keeping the number of model parameters at a minimum. It permits the simulation of the nonlinear response of the watershed

elements to the meteorological input. The model calibration and validation were carried out by using data available in a river basin in southern Ontario. A more detailed analysis of the calibration-validation results is presented in the third paper of the series.

DATA:

Secondary Source; refer to Water Survey of Canada data.

350. SOZANSKI, A.G.
1974: Geochemistry of Ferromanganese Oxide Concentrations and Associated Sediments and Bottom Waters from Shebandowan Lakes, Ontario; Unpublished M.Sc. Thesis, Department of Geology, University of Ottawa, 142 p.

ABSTRACT:

Littoral ferromanganese concentrations have been collected from 50 localities in Shebandowan Lakes, Ontario, a multi-basin complex 30 miles long. The average composition of the concretions: 43.1% Fe, 5.65% Mn, 0.538% Ca, 200 ppm K, 669 ppm Mg, 31 ppm Cu, 273 ppm Zn, 101 ppm Ni and 102 ppm Co, is similar to that of concentrations from other North American and Fennoscandian lakes. X-ray diffraction and Mössbauer spectroscopic methods detected the presence of goethite and other unidentified ferric oxyhydroxide minerals. Observation of the growth habits of hundreds of concretion show tha they form at the sand-water interface by concentric accretion in that place, with a tendency to deviate in both up and down directions at the edges, possibly illustrative of a dual source of elements. Partial re-solution of bottom and top concretion surfaces is likely responsible for maintaining the overall flat growth. Sediment cores at concentration sites have upwardly increasing Mn and Fe contents and Mn/Fe ratios, implying a diagnenetic accrual of these metals to concretions by transport from profundal to littoral sediments. A hydrogenous component of the metals' accrual is indicated by the presence of upfolded edges on common discoid concretions and of upperside botryoidal growth, the latter best observed on mushroom-type morphologies. Somewhat higher Mn/Fe ratios in concretions of deposits sub-tending the deeper basins is probably explicable by diagenetic segregation of Mn and Fe over a longer distance than in shallower basins.

DATA:

Primary Source.

351. SOZANSKI, A.G. and CRONAN, D.S.
1979: Ferromanganese Concretions in Shebandowan Lakes, Ontario; Canadian Journal of Earth Sciences, Vol. 16, No. 1, p. 126-140.

ABSTRACT:

Shebandowan Lakes, Ontario, are the site of at least 49 shallow (2-12 m) ferromanganese concretion deposits, widely distributed throughout the 48 km of the watercourse.

X-ray diffraction and Mössbauer methods have revealed the presence of goethite in some of the concretions. Chemical analyses of the acid soluble portions of 72 samples gave an average composition of 43.1% Fe and 5.65% Mn with a low content of trace elements. The Shebandowan concretions are among the richest in iron of lake concretions reported, possibly because only the acid soluble portion was analysed. Their low content of trace elements suggests rapid growth rates and a relatively young age. A positive correlation was found between Mn and K, Ca, Mg, Cu, Ni, and Co and the relationship between the last three and Mn was deemed significant. Zn was independent of association with either Mn and Fe, probably due to the presence locally of zinc sulphide deposits.

Analyses of lake bottom and influent waters suggested that frequent resampling of the sites would be required throughout the year to permit meaningful interpretation of the effect of water composition on the composition of concretions. Analyses of sediment cores from 20 concretion sites indicated an upward increase in Fe and Mn and in the Mn/Fe ratio, consistent with the model of upward migration of the elements, where Mn is more mobile than Fe.

This study concludes that a considerable proportion of the elements have been supplied to the Shebandowan concretions via the diagnetic process; generally a minor fraction of the elements has been abstracted directly from the superjacent water.

DATA:

Secondary Source; refer to Sozanski (1974).

352. SPIRES, A. and MILLER, M.H.
1978: Contribution of Phosphorus from Agricultural Land to Streams by Surface Runoff; Report, Task Group C (Canadian Section), Activity 1, Project 18, PLUARG, International Joint Commission, Windsor, 101 p.

ABSTRACT:

The objective of this project was to develop a capacity for prediction of the amount of phosphorus carried to streams by surface runoff from agricultural cropland in Ontario.

The project has succeeded in developing relationships for estimation of total phosphorus concentration in surface soils in Ontario and for prediction of the phosphorus enrichment ratio. However, it has not been as successful in predicting the sediment load, the third parameter required for estimating the contribution of phosphorus. The difficulty in predicting the sediment load is due to difficulty in estimating the sediment delivery ratio.

Although sediment-associated phosphorus loss could be estimated, it was not possible to develop a relationship to predict dissolved phosphorus concentrations in runoff.

The study has improved our understanding of the processes involved in phosphorus loss from cropland and its transport to stream. Although the development of the predictive capacity has not been fully realized, the understanding obtained will greatly assist in interpretation and extension of the monitoring data from the Agricultural Watersheds Study.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

353. STEVENATO, R.J. and VOS, M.A.
1984: The Application of Lake Sediment Geochemistry of Exploration for Lithium Regmatites in Northern Ontario; Ontario Geological Survey, Open File Report No. 5500, 66 pp.

ABSTRACT:

This report presents the results of an attempt to use lake sediment geochemistry as a regional-scale exploration tool for lithium-rich pegmatites. Samples, originally collected from an area of some 27,700 sq.km. north and west of Lake Superior (NTS map sheets 42D, 42E(S1/2), 52A and 52H(S1/2)) and analyzed as part of the Federal- Provincial Uranium Reconnaissance Program, were analysed for lithium, rubidium and cesium (1782 samples) and for tin and tantalum (204 of the 1782 samples, selected from three areas within the larger project area). Visual and statistical interpretations of these data were made in attempts to correlate anomalous element concentrations with bedrock geology, lake size and topographic relief.

DATA:

Primary Source.

354. STEWART, A.L.
1981: The Effects of Mercury, Cadmium and Lead on Sediment Microorganisms; Unpublished M. Sc. Thesis, Department of Biology, University of Waterloo, Waterloo, 164 p.

ABSTRACT:

The effects of mercury, cadmium and lead on sediment microorganisms were investigated. Particular emphasis was placed on the effects of temperature and redox potential on the toxicity of these metals. A sediment incubation system which allows for direct microscopic observation of different depths of sediment was built and used in toxicological bioassays. The sediment incubation system of Polonenko et al. (1978) was also used for toxicological studies of sediment microorganisms and the results from these studies were compared to those obtained from enumeration of microorganisms on solid media and pure culture broth studies.

Temperature and Eh affected population growth rates and composition on non-treated sediments, and interacted with the heavy metals to modify their toxicity to the sediment microorganisms. In broth, solid media and sediment chamber studies, mercury had greater toxicity at 0 and 4°C than at 15°C, whereas the reverse was true for cadmium. Mercury $EC_{50}$ concentrations increased 50 fold for one isolate in pure culture at 4°C, as compared to the toxicity at 15°C. When the entire population response was assessed by direct microscopic observation, the toxicity of mercury increased 45 fold at 0°C as compared to the toxicity at 15°C. The sediment population was 4.5-fold more resistant to cadmium at the lower temperature than 15°C. Cadmium $EC_{50}$ concentrations for an isolate in pure culture were 1.8-times higher at 4°C than at 15°C. Lead toxicity to a bacterial isolate in broth was not affected by a temperature change from 4 to 15°C; but lead was more toxic at the higher temperature in the direct observation system. Changing the redox potential from +100 mv to -200 mv changed the microbial response to mercury and lead but not to cadmium. The toxicity of mercury and lead was greater under anaerobic conditions at 0 and 4°C but under anaerobic conditions at 15°C the toxicity of mercury and lead were decreased.

Certain concentrations of cadmium of lead caused increases in the numbers of fungi. The percentage of cells which were not attached to sediment increased following mercury treatment.

DATA:

Primary Source.

355. STICHLING, W.
1973: Sediment Loads in Canadian Rivers; Proceedings of the 9th Canadian Hydrology Symposium on Fluvial Processes and Sedimentation, University of Alberta, Edmonton, May 8-9, 1973, p. 38-72.

ABSTRACT:

New development of water resources in Canada demands more and better information on hydrological and morphological processes in streams and watersheds.

This paper reviews the history of the sediment data collection program initiated in Canada in 1961, describes the latest equipment in use for measuring suspended sediment and bed load and outlines the methods used by the Water Survey of Canada for collecting and processing data. The paper compares sediment data collection technique in use in Canada with those of other countries, and also compares sedimentation conditions and sediment yield.

Because information on sediment in Canadian streams is limited, existing data were reviewed and expanded to a standard period by using existing records where these were available and estimating where records were not available. Sediment load was estimated for as many watersheds as possible by establishing a relationship between sediment load on the one hand and flow and other physiographical parameters on the other. The average suspended sediment concentration and the average suspended sediment yield per square mile per year were computed and tentative maps for these two parameters prepared.

DATA:

Secondary Source; refer to Water Survey of Canada data.

356. STOCKNER, J.G.
1971: Preliminary Characterization of Lakes in the Experimental Lakes Area, Northwestern Ontario, Using Diatom Occurrences in Sediments; Journal of the Fisheries Research Board of Canada, Vol. 28, No. 2, p. 265-275.

ABSTRACT:

Diatoms in deepwater surface sediment from 16 Experimental Lakes Area (ELA) lakes of varying size and morphometry were separated for analysis on the basis of their generally understood habitat preference into littoral and planktonic crops. The lakes were ranked in order of increasing relative abundance of littoral diatoms recovered from deepwater surface sediment. A significant correlation was found between the abundance of littoral diatoms in deepwater sediment and the morphometric variables: lake surface area ($A_o$), an shoreline length to lake volume (L/V), and

percent littoral development in each lake. The Centrales was the dominant planktonic group in most of the ELA lakes examined. Species of Cylotella and Melosira were the dominant diatoms in most ELA lakes. The ratio of the two planktonic groupe - Araphidineae and Centrales (A/C) - calculated from sediment counts, agreed closely with the A/C ratio enumerated from 1969 phytoplankton counts in two lakes compared. Based on a lake classification scheme using values of the A/C ration from sediment diatom counts, the majority of ELA lakes were classed as oligotrophic. Analysis of a 155-cm core from lake 240 showed little change in diatom species composition over the past 3000-4000 years. Centrales was the dominant diatom assemblage at all sediment depths. The dominant diatoms in the sediment of lake 240 and the majority of ELA lakes examined were similar to those dominant in the deepwater sediments of well-studied oligotrophic lakes in other lake districts. On the basis of calculated A/C ratios in surface sediment in several lakes at temperate latitudes, a lake trophic classification is proposed.

DATA:

Primary Source.

357. TAM, T.-Y.
1981: Microbial Activities in a Stream Sediment - Water System Amended with Leaf Material; Unpublished M.Sc. Thesis, Department of Biology, University of Waterloo, Waterloo, 154 p.

ABSTRACT:

The in vitro microbial activities in a stream sediment-water system amended with either fresh or autumn-shed leaves were studied. A rapid direct epifluorescence microscopic technique was developed to enumerate microbial populations colonizing leaf detritus and thus allow estimation of the surface area of leaf detritus colonized by microorganisms.

Microbial colonization and mineralization of leaf detritus were greater at 20°C than at 0°C and also greater with fresh leaves than autumn-shed leaves. The majority of the microorganisms involved in mineralization and colonization of leaf detritus were probably psychrotrophic or psychrophilic. Total carbohydrate and total protein contents were higher in fresh leaves than in autumn-shed leaves. Bacteria were more important and numerous than fungi in mineralization and colonization of leaf detritus.

Denitrogen fixation, denitrification, methanogenesis and, indirectly, methylotrophic activity were stimulated by the addition of leaf material to the system. Dinitrogen-fixing and methanogenic activities were higher in the presence of fresh leaves than autumn-shed leaves.

Sulfide at low concentrations stimulated dinitrogen fixation but had no effect on glucose mineralization. Sulfide at high concentrations inhibited both dinitrogen fixation and glucose mineralization. The effect of sulfide on dinitrogen fixation and glucose mineralization was not solely due to the lowered redox potential.

DATA:

Primary Source.

358. TAYLOR, B.R. and ROLF, J.C.
1982: Transport and Particle Size Distribution of Suspended and Benthic Organic Matter in Three Headwater Streams; Hydrobiologia, Vol. 93, No. 3, p. 281-288.

ABSTRACT:

Suspended and benthic organic matter transported by three streams of different character in southern Ontario were assessed. Rates of sediment deposition varied according to the riparian vegetation at a stream reach, but suspended POM concentrations showed little change within a stream. Particle size distributions of suspended POM were characterized by two peaks, one in the 30 to 110 µm class, the other in the <10 µm class. Decreases in POM between sites were related to loss of coarse particles, and an increase in the height of the <10 µm peak. Overall it appeared that the nature of allochthonous inputs and physical features such as water velocity were most important in determining the character of suspended and benthic POM in these streams.

DATA:

Primary Source.

359. TESSIER, A., RAPIN,, F. and CARIGNAN, R.
1985: Trace Metals in Oxic Lake Sediments: Possible Adsorption onto Iron Oxyhydroxides; Geochimica et Cosmochimica Acta, Vol. 49, No. 1, p. 183-194.

ABSTRACT:

Apparent overall equilibrium constants for the adsorption of Cd, Cu, Ni, Pb and Zn onto natural iron oxyhydroxides have been calculated from the partitioning of these trace metals in oxic lake sediments and the in situ measurement of trace metal concentrations in the associated pore waters. Such values obtained from lakes of various pH located on the Precambrian Shield, in the area of Sudbury, Ontario, are compared with equilibrium constants obtained for the adsorption of the trace metals onto iron oxyhydroxides in well-defined media.

The field data are consistent with laboratory experiments reported in the literature and with theory. Both the influence of pH upon adsorption and the binding strength sequence observed for the field data agree with theory. At high sediment pH values, the partitionning of Cd, Ni, and Zn between the pore waters and the natural iron oxyhydroxides is similar to those reported in the literature for the adsorption of these metals at low surface coverage onto amorphous iron oxyhydroxides in a $NaNO_3$ medium; deviation from this simple model is however observed for Cu and Pb, presumably due to the competitive action of dissolved ligands. At low sediment pH values, the adsorption is much higher than predicted by the simple model, and can be explained by the formation of ternary complexes with the iron oxyhydroxide surface.

DATA:

Primary Source.

360. THODE, M.G. and DICKMAN, M.
1978: Sediment Sulfur Distribution and its Relationship to Lake Acidification in Four Lakes North of Lake Superior; Report, Hamilton, Ontario, 103 p.

ABSTRACT:

The sulphur isotope fractions and ratios in the sediments of four lakes north of Lake Superior were analyzed in order to determine whether these ratios were valid indicators of the source of their sulphur. The four lakes were immediately downwind of the Wawa siderite sintering plant which annually discharges roughly 300,000 tons of $SO_2$ and fly ash. Lake sediments were analyzed for sulphate, pyrite, organic and total sulphur as well as subfossil diatoms. The rate of lake acidification was based on inferences of downcore pH from the ratio of acid to alkaline loving diatoms inferred pH indicated that only one of the four lakes was undergoing rapid acidification. Organic plus pyrite sulphur comprised the major fraction of sulphur in the sediments of all four lakes. Lakes closest to the sintering plant had the highest sulphur concentrations in their sediments. In addition, the surface sediments which were taken from these lakes had significantly higher pyrite concentrations than deeper sediments.

DATA:

Primary Source.

361. THOMAS, R.L. and FRANK, R.
1983: PCB's in Sediment and Fluvial Suspended Solids in the Great Lakes; In: Physical Behaviour of PCB's in the Great Lakes, D. Mackay, S. Paterson, S.J. Eisenreich and M.S. Simmons, editors, Ann Arbor Science, p. 245-267.

ABSTRACT:

The present paper is intended to collate and present as a composite the work described by Frank and co-workers, with respect to the levels and distribution of PCB's in the sediment and fluvial suspended solids in the Great Lakes.

DATA:

Secondary Source; refer to Frank (1981) and Frank et al. (1977; 1981).

362. THORNLEY, S. and HAMDY, Y.
1984: An Assessment of the Bottom Fauna and Sediments of the Detroit River; Report, Ontario Ministry of the Environment, Water Resources Branch, Great lakes Section, 48 p.

SUMMARY:

A comparison of biological surveys of the Detroit River in 1968 and 1980 showed differences in the types and distribution of benthic organisms recovered. The major difference was a dissimilarity in the macrozoobenthos comparing the American and Canadian shorelines.

A balanced community structure indicative of satisfactory water quality conditions existed along the entire Canadian shoreline both in 1968 and 1980. Canadian sources impacting on the biology did not seriously disrupt the macrozoobenthos.

In contract, along the American shoreline, a seriously disrupted benthos was evident. The disruption began at the mouth of the Rouge River and was clearly evident both in 1968 and 1980. The macrozoobenthos near the mouth of the Rouge River was greatly reduced in numbers and types of organisms. downstream from the Rouge River pollution-tolerant aquatic worms numbered over 1 million per $m^2$ of river bottom during both surveys, demonstrating persistent and severe organic enrichment. High numbers of worms, representing a lesser degree of enrichment, persistent along the shore to the mouth of the river.

Differences over time were detected in the macrozoobenthos of the Detroit River comparing 1968 and 1980 data. There was an increase in the types of organisms recovered in 1980, particularly along the Canadian shoreline. Also, certain organisms indicative of satisfactory water quality such as the mayfly, Hexagenia limbata, were better represented in the river in 1980. The mayfly was found at 70% of stations in 1980 compared to only 26% in 1968. The recovery of the mayfly was particularly noticeable in the centre and along the Canadian shoreline of the river and is indicative of improved conditions. The occurrence of mayfly along the American shoreline, although somewhat improved in 1980, was

still meager compared to stations in the middle of the river and along the Canadian shoreline. Satisfactory water quality conditions are still not evident along most of the American shoreline.

The river sediments are mainly characterized by coarse materials due to moderate to high current velocities which carry the fine particles to the depositional zones in Lake Erie. Contaminants found in the sediments are mainly attributable to discharges from the U.S. shoreline of the river. Metal concentrations were, in general, highly intercorrelated along the U.S. shore, indicating that continuous, rather than discrete sources, were responsible. Along the Canadian shore, metal concentrations was generally poor.

The contamination of sediments along the Ontario shoreline of the river was localized near known sources such as the Little River, West Windsor sewage treatment plant, Turkey Creek and Riviere aux Canard. Almost the entire U.S. shoreline sediments exhibited elevated levels (above provincial dredging guidelines) of contaminants such as heavy metals and PCBs. Levels of one order of magnitude higher than those on the Canadian shore were prevalent along the U.S. shore. Sediments around Fighting Island indicated levels well below the Ministry of the Environment (MOE) dredging guidelines.

The decline of mercury levels in the river observed during the period 1970-1980 is attributed to the controls that were instituted on mercury losses (e.g. U.S. Wyandotte). Significant increases in cadmium, chromium, copper, lead, nickel and zinc in the vicinity of the mouth of the Rouge River along the U.S. shoreline during the same period suggest recent inputs from industrial and municipal sources.

DATA:

Primary Source.

363. TIPPETT, R.
1964: An Investigation into the Nature of the Layering of Deep-Water Sediments in Two Eastern Ontario Lakes; Canadian Journal of Botany, Vol. 42, No. 12, p. 1693-1709.

ABSTRACT:

The sediments deposited beneath the thermocline in certain lakes are finely banded with alternating dark and light bands. Most workers have assumed this banding to be an annual phenomenon, with the light bands representing summer deposits and the dark bands representing winter deposits. The microfossils contained in each layer, particularly pollen and diatoms, should represent the flora of the time of year at which the sediment was deposited. If this banding is annual, different species will be consistently associated with particular parts of a pair of layers.

Pollen and diatom contents of individually separated dark and light layers from different depths of a core were analyzed. Pollen produced in late spring and early summer, and summer forms of diatoms, are associated with light layers whereas pollen produced early in the year, in winter diatoms, are associated with dark layers. The junction between layer types and the position of fossils in each layer were studied by observing sections cut from wax impregnated sediment blocks. The light layers contain much more calcareous material than the dark layers. From all evidence accumulated it is concluded that the layering is annual.

DATA:

Primary Source.

364. TOWNSEND, D.R., KUDO, A., SAYEED, M. and MILLER, D.R.
1974: Mercury Transport by Bed Sediment Movements; Proceedings of the International Conference on Transport of Persistent Chemicals in Aquatic Ecosystems, Ottawa, May 1-3, 1974, p. I47-I51.

ABSTRACT:

Representative samples of Ottawa River sediments were collected from numerous locations in the study section for purposes of material classification and grain-size distribution analysis. Three basic materials were identified as sands, clays, and organics (wood chips).

Although non-cohesive sediments (fine to coarse sands) constitute the predominant sedimentary material in the main channel, wood chips mixed with very fine sand and clay fractions were found to be predominant materials in specific locations.

Sorption capacity of mercury by bed sediments was found to vary with particle size and sediment type. Sizes less than 38 μ but greater than 0.45 μ had approximately 99 times higher sorption capacity than that of sand particles ranging from 100 μ to 150 μ. With regard to sediment types it was found that the wood fibre matrix had a higher sorption capacity than sands.

A 2-dimensional pressurized flume is being used in the laboratory investigation to assess critical values of governing flow parameters (velocity, boundary shear stress, etc.) at which movement of particles takes place.

DATA:

Primary Source.

365. TOWNSEND, D.R., MILLER, D.R. and KUDO, A.
1977: Laboratory Studies of Mercury Transport by Bed Sediment Movements; In: Distribution and Transport of Pollutants in Flowing Water Ecosystems, D.R. Miller, editor, Final Report of the Ottawa River Project, p. 10.1-10.19.

ABSTRACT:

The results indicate that mercury associated with bed sediments remains in its original burying position after flowing water is introduced. The mercury is gradually transported downstream attached to the moving sediment particles. The 'Saltation length' for bed load movements is several centimeters for sand particles, however saltation is not observed for wood chip particles. A significant difference in velocity of mercury transport is obtained between woodchip and sand sediment samples. This difference in velocity decreases with a decrease in the mean water velocity.

DATA:

Primary Source.

366. TURNER, J.V. and FRITZ, P.
1983: Enriched $^{13}C$ Composition of Interstitial Waters in Sediments of a Freshwater Lake; Canadian Journal of Earth Sciences, Vol. 20, No. 4, p. 616-621.

ABSTRACT:

The DIC (dissolved inorganic carbon) of interstitial waters from sediments of a small carbonate-precipitating lake in southern Ontario has highly enriched $\delta^{13}C$ values of up to +13% relative to PDB (Peedee belemnite). This post-depositional isotopic enrichment is attributed to the metabolism of methanogenic bacteria. The $\delta^{13}C$ values of marl in the sediment profile are also enriched by an average of +3 to +4% relative to the associated molluscs.

Photosynthetically induced carbonate precipitation and post-depositional recrystallization are among the processes that are considered to contribute to the isopopically enriched marls. Evidence for the latter process is drawn from geochemical analyses on interstitial waters, which show them to be at or very close to saturation with respect to calcite, indicating that net calcite dissolution has occurred, probably under the influence of high $\rho CO_2$'s generated by methanogenic bacteria. Such freshwater carbonate sediments with interstitial waters enriched in $^{13}C$ provide a unique environment for study of isotope relations during carbonate diagenesis under accessible conditions and with a time scale or geologic relevance.

DATA:

Primary Source.

367. VAN VLIET, L.J.P., WALL, G.J. and DICKINSON, W.T.
1976: Effects of Agricultural Land Use on Potential Sheet Erosion Losses in Southern Ontario; Canadian Journal of Soil Sciences, Vol. 56, No. 4, p. 443-451.

ABSTRACT:

Potential sheet erosion losses from 13 agricultural watersheds were investigated to assess the effects of agricultural land use on soil erosion levels. The agricultural watersheds, ranging in size from 19 to 54 $km^2$, were representative of the predominant livestock and cropping management systems in the major physiographic and climatic regions of Southern Ontario. Average annual sheet erosion losses were estimated on a field basis using the universal soil loss equation. Rainfall intensity and soil and topographic variability were considered in deriving mean annual soil losses for a range of field crops. Crops yielding the highest annual sheet erosion loss estimates were row crops, such as horticultural cash crops (9.1 ton/ha/yr), beans (7.6 ton/ha/yr), and continuous corn (6.7 ton/ha/yr). Erosion losses from crops in rotations with grasses or legumes (corn, small grains, meadow) and from tobacco were determined to be approximately one half of values obtained for continuous row cropping systems. Lowest sheet erosion losses occurred on permanent pasture and woodlands (<0.5 ton/ha/yr). Results of this study suggest that on a regional basis, the intensively farmed cash crop areas have higher erosion potentials than areas with rotational cropping systems. Watersheds with a low potential for sheet erosion often are dominated by livestock operations, where a large percentage of the area is represented by grasses or legumes and permanent pasture.

DATA:

Primary Source.

368. VAN VLIET, L.J.P., WALL, G.J. and DICKINSON, W.T.
1978: Soil Erosion from Agricultural Land in the Canadian Great Lakes Basin; Combined Final Report, Task Group C (Canadian Section), Activity 1, Projects 16 and 17, PLUARG, International Joint Commission, Windsor, 166 p.

ABSTRACT:

This report describes the results of several integrated projects (Project 16: Erosional Losses from Agricultural Land and Project 17: Sediment Delivery Ratios in Small Agricultural Watersheds, and Sediment Integration Aspects) designed to further our understanding of the sources and magnitude of fluvial sediment derived from agricultural lands and delivered to the Canadian Great Lakes. Agricultural regions with high potential sheet erosion losses were intensively farmed with high percentages of

row crops (beans, corn, horticultural crops). Rainfall-induced soil erosion losses showed considerable year to year variations and are not equally distributed throughout any given year. Winter soil erosion losses associated with snowmelt events can account for up to 25% of the total annual soil loss.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

369. R.L. WALKER and PARTNERS
1974: Contribution of Sediments and other Pollutants to Receiving Waters from Major Urban Land Development Activities; Consulting Report to Environment Canada, 50 p.

ABSTRACT:

This report provides a preliminary evaluation of soil erosion and pollution problems and soil conservation practices appropriate to major land development activities within the Canadian portion of the Great Lakes Basin. The studies have been based upon an extensive review of published literature and other source documentation provided by government and private sources both from Canada and the United States.

DATA:

Secondary Source; refer to Water Survey of Canada and Ontario Ministry of the Environment data.

370. WALKER, R.R.
1980: Modelling Sediment Oxygen Demand in Lakes; Unpublished M.Sc. Thesis, Department of Engineering, McMaster University, Hamilton, 244 p.

ABSTRACT:

Field and laboratory investigations were carried out to explore sediment oxygen demand (SOD) and its component parts. An in situ measurement device was built, tested and applied in Hamilton Harbour. Techniques were developed to measure SOD and oxygen uptake by chemical oxidation (CSOD). Sediment samples were taken from Hamilton Harbour and seven other lakes in Northern Ontario and Cape Breton Island. All samples were analyzed for organic content and selected samples were placed in laboratory columns. Experiments were conducted in which oxygen uptake was measured within the columns under controlled conditions. Sediment oxygen demand was fractioned into portions attributable to chemical oxidation, biological respiration and direct macroinvertebrate respiration.

Models were selected to describe the dependence of each portion of SOD on oxygen concentration and temperature. Where possible, mechanistic explanations are presented for the models selected. Results indicate that the chemical portion of SOD is dependent on oxygen concentration in the manner of a first-order reaction and that is responds to temperature change in a manner typical of a mixed bacterial community. At high oxygen concentrations, anaerobic metabolic activity is found to be the limiting factor in CSOD. Bacterial and macroinvertebrate oxygen uptake are dependent on oxygen concentration at low concentrations, following a Monod kinetic form. These fractions respond to temperature in the same fashion as the chemical portion. Macroinvertebrates contribute a large part of the direct respiration as well as having a profound effect on the total community respiration.

DATA:

Primary Source.

371. WALKER, R.R. and SNODGRASS, W.J.
1986: Model for Sediment Oxygen Demand in Lakes; Journal of Environmental Engineering, Vol. 112, No. 1, p. 25-43.

ABSTRACT:

A model for sediment oxygen demand (SOD; $g/m^2d$-) in lakes is hypothesized and developed for aerobic (BSOD) and chemical (CSOD) components. The CSOD use first order kinetics while BSOD uses Monod kinetics with respect to oxygen concentration. The model is calibrated using laboratory data for sediments from 4 water bodies - one is heavily impacted by eutrophication and wastewater discharges while the other 3 lay on the forested Precambrian shield. The model shows excellent agreement with the laboratory data for all water bodies (generally at the 1% level of significance) for temperatures between 4°C and 22°C. The model implies that CSOD is diffusion controlled at one temperature, but strongly influence by anaerobic biological processes over a range of temperatures. Future research should aim to incorporate overlying water velocity and sediment biodecomposability into kinetic expressions to complete model development.

DATA:

Secondary Sources; refer to Walker (1980).

372. WALL, G.J.
1981: Agricultural Soil Erosion: A Crop Production and Water Quality Problem; In: Erosion and Sedimentation in Ontario, a Time for Action, some Papers from the Winter, Summer and Fall Meetings of the Ontario Chapter, Soil Conservation Society of America, Erosion and Sedimentation, Erosion and the Rural Landscape, SCSA - OIA Joint Meeting, November 18, 1977, Embro, Ontario, p. 68-73.

ABSTRACT:

This paper illustrates the two aspects of the agricultural soil erosion problem which are crop production and water quality. It discusses the implications to farm planning for soil and water conservation. Tolerable soil loss levels are discussed. In Ontario, an average annual soil loss tolerance of 7-10 tons ha for most solid will permit the maintenance of a high level of productivity. However, when agricultural erosion contributes directly to streams, an annual soil loss tolerance of less than 1 ha is more realistic in terms of water quality objectives. The most important factors affecting agricultural erosion are usually considered to be rainfall-runoff, soil erodibility, slope gradient and length, vegetation and conservation measures. Each of these are discussed and a table illustrates soil loss levels for crops commonly grown in Southern Ontario. While soil erosion occurs over the entire agricultural landscape, it is only a relatively small percentage of agricultural land that has the potential to contribute contaminants to streams. A table illustrates field situations with high potential to impact upon stream water quality. Farm planning for soil and water conservation requires information on the relationships between those factors that cause soil erosion and those practices that may reduce such losses.

DATA:

Primary Source.

373. WALL, G.J., Dickinson, W.T. and VAN VLIET, L.J.P.
1979: Agricultural Sources of Fluvial Suspended Sediments; Progress in Water Technology, Vol. 11, No. 6, p. 481-499.

ABSTRACT:

A detailed study regarding areas that contribute sediment into the streams of two small agricultural watersheds in Canada has revealed that these areas may be expected to (i) constitute a relatively small percentage of the total watershed area, (ii) be highly variable from season to season, year to year, and basin to basin, and (iii) be in close proximity to streams. The sediment contributing area during high basin moisture spring conditions is essentially equivalent to the runoff contributing area. Areas contributing runoff during low moisture conditions in the spring and fall are considered to be potential rather than active sediment producing areas. High sediment producing areas are located close to stream channels, but the distribution and significance of sediment producing categories and their location varies from basin to basin. Management strategies for controlling sediment production in agricultural areas should therefore be closely linked to a consideration of sediment source areas and their variability and space.

DATA:

Secondary Source; refer to Van Vliet et al. (1978).

374. WALL, G.J., DICKINSON, W.T. and VAN VLIET, L.J.P.
1982: Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments; Journal of Environmental Quality, Vol. 11, No. 3, p. 482-486.

ABSTRACT:

Unit-area yield of suspended sediments discharged from 11 small (<6,000 ha) agricultural watersheds in southern Ontario ranged from <100 to 1,000 kg $ha^{-1}year^{-1}$ in a 2-year study. Estimated bank erosion contributed between 0 and 30% of the suspended sediment, while estimated cropland sheet and rill erosion contributed 70-100%. Regression analyses relating 14 watershed characteristics to unit-area yields showed that percent clay of the surface soil and percent row crop were the most significant ($R^2$ = 0.64) factors in estimating suspended sediment yields.

Detailed studies in the agricultural watersheds were used to generate and test three independent methods for the prediction of suspended sediment yields from cropland. The agricultural contribution to suspended sediment were predicted for the Grand and Saugeen river basins and for the over 300 subbasins of the Canadian Great Lakes Basin. It was estimated that agricultural land-use activities contribute over 650 x $10^3$t of suspended sediment to the Great Lakes annually.

DATA:

Secondary Source; refer to Water Survey of Canada and Ontario Ministry of the Environment data.

375. WALL, G.J., VAN VLIET, L.J.P. and DICKINSON, W.T.
1978: Contribution of Sediments to the Great Lakes from Agricultural Activities in Ontario; Report, Taks Group C (Canadian Section) Activity 1, PLUARG, International Joint Commission, Windsor, 41 p.

ABSTRACT:

The objectives of this study were: to identify the sources of erosion and sediment production in rural landscapes and assess the relative significance of each source; to establish the magnitude of soil erosion and stream sediment load from rural land; to establish a method of predicting soil erosion and stream sediment loads; and to assess remedial measures. The report summarizes the results of the 3 year study. Highest sediment loads were observed in intensively farmed regions characterized by a high percentage of row crops, fine textured soils and an efficient transport system that delivers eroded sediments to the stream. The predominant sources of sediments to streams are sheet and rill erosion from cropland, and streambank erosion, and most occurs in February, March and April. Two methods of predicting sediment loading rates from agricultural land have been evaluated in the

Grand and Saugeen River watersheds. Localized variations in pollutant sources, soil properties and landscapes, sediment contributing areas and cropping systems, make generalizations about remedial sediment control programs impossible. Erosion and transport of sediments from agricultural land is a site-specific problem requiring site-specific remedial measures.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

376. WARNOCK, R.G. and KHAN, S.I.
1974: Suspended Solids and Velocity Distributions in the Ottawa River; Proceedings of the International Conference on Transport of Persistent Chemicals in Aquatic Ecosystems, Ottawa, May 1-3, 1974, p. I99-I104.

ABSTRACT:

The paper summarizes results of velocity measurements made over a 5-year period and results of suspended solids measurements. Velocity measurements were made with a rotating-type velocity meter which measures the velocity in a horizontal plane. The variation of velocity with depth, when plotted in a non-dimensional form follows a general form. This variation was used to estimate the depth-averaged velocity from measurements of surface velocity. The results of a float survey to determine the instantaneous distribution of velocity in the river were found to agree well with measured values of the total flow and the cross-sectional variation of velocity. Distributions of velocity under an ice cover were also determined.

Measurements of suspended solids showed a seasonal variation. Values were usually high in the spring, lower in the late summer and somewhat higher in the fall. There was little variation of suspended solids with depth. Lateral variations were evident which were caused by tributary inflows or local effluents.

DATA:

Primary Source.

377. WARRY, N.D. and CHAN, C.H.
1981: Organic Contaminants in the Suspended Sediments of the Niagara River; Journal of Great Lakes Research, Vol. 7, No. 4, p. 394-403.

ABSTRACT:

Suspended sediment samples were collected approximately every 2 weeks from the Niagara River at Niagara-on-the-Lake between April,

1979 and April 1980. Three other samples were collected from the Fort Erie end of the river during July, 1979. All samples were analyzed for organochloride pesticide residues.

Of the residues tested, PCB was the most prevalent, followed by DDT, mirex, chlordane, methoxychlor, and endosulfan. The Niagara River is apparently the largest single source of PCBs to Lake Ontario. Comparison with other work indicates that the loadings of total PCBs from this source have more than doubled since 1968.

Evidence suggests that much of the suspended sediment contaminated with PCB, mirex, and p,p'-DDT emanates from sources which enter the Niagara River between Grand Island and Niagara-on-the-Lake.

DATA:

Primary Source.

378. WASLENCHUK, D.G.
1975: The Distribution and Transport of Heavy Metals in the Bed Sediments of the Ottawa River; Unpublished M.Sc. Thesis, Department of Geology, University of Ottawa, 184 p.

ABSTRACT:

The sandy sediments of a three mile study section on the Ottawa River are supplied largely by the Gatineau River (a nearby tributary of the Ottawa) as indicated by provenance studies made on the heavy mineral assemblage. Unlike the metamorphic mineral grains of the Gatineau, sedimentary rock fragments introduced by another tributary, the Rideau River, do not survive in the Ottawa.

Geochemical studies indicate that components of the bed material with high surface area to volume ratios, namely fine grains and wood debris, control in part the concentration of iron hydroxide coatings on the bed material. The Fe coatings in turn provide sites for adsorption and coprecipitation of Hg and Mn and thus control their concentrations. Current speed also affects the precipitation of Fe hydroxide, such that higher concentrations of Fe, and thus of Hg and Mn, are found in areas of quiescent flow conditions.

Hg concentration levels in the study section bed sediments are declining, with a half-life on the order of 12 months. Chemical desorption and transportation of contaminated grains out of the study area are indicated as the mechanisms responsible for the decrease.

Sand dunes ranging from .5 to 3 meters in height and 10 to 70 meters in length vary in size according to water depth. A ripple bed prevail in areas where depth is less than about 5 meters, and a plane bed prevails in areas of cohesive sediments.

Two methods were used to determine the bed load discharge, a dune-tracking method utilizing sonic depth-sounding, and a bed load sampling method employing a diver operated bed load sampler designed for the project. Results from the two methods are in good agreement, with discharge on the order of $4 \times 10^5$ kg. bed sediment per day.

The weight of adsorbed Hg discharged with the bottom sediments is on the order of 10 grams/day.

DATA:

Primary Source.

379. WASLENCHUK, D.G.
1975: Mercury in Fluvial Bed Sediments Subsequent to Contamination; Environmental Geology, Vol. 1, No. 3, p. 131-136.

ABSTRACT:

Once inputs of mercury-bearing effluents to a fluvial system are stopped, levels of contamination will decline slowly to background values. Crystalline mercury phases will dissolve in response to lowered aqueous mercury concentrations, and aqueous $Hg(OH)_2$ will desorb from ferric hydroxide grain coatings as the coatings age to more ordered phases. In the Ottawa River, mercury concentrations in bed sediments are declining by about 50 percent annually.

DATA:

Secondary Source; refer to Miller (1977).

380. WATT, E., DEMAYO, A. and FORBES, M.
1984: Polynuclear Aromatic Hydrocarbons in Bottom Sediment Samples of Rivers, Lakes and Harbours; Report, Environment Canada, Inland Waters Directorate, Water Quality Branch, 40 p.

ABSTRACT:

The Water Quality Branch, Inland Waters Directorate, carried out a national survey to obtain a broad indication of typical ranges of polycyclic aromatic hydrocarbnos (PAHs) in the aquatic environment. Thirty sites were sampled and the concentrations of fluoranthene, benzo (b) fluoranthene, benzo (k) fluoranthene, benzo (g,h,i) perylene, benzo (a) pyrene and indeno (1,2,3-cd) pyrene were determined.

DATA:

Primary Source.

381. WESKA, E.
1977: Geochemistry and Hydrogeology of Agricultural Watershed No. 10, and Their Influence on the Chemical Composition of Water and Sediments; Report, Task Group C (Canadian Section), Activity 1, Project 23, PLUARG, International Joint Commission, Windsor, 119 p.

ABSTRACT:

The objective of this study was to examine the distribution of twenty elements in bottom and suspended sediments, and stream and well waters in Watershed No. 10, tributary of the Twenty Mile Creek on top of the Niagara Escarpment, Ontario. It was hoped that this study would determine the sources and causes for contaminants in surface and ground waters. These contaminants can often be correlated with soils, topography, geology or to some form of land use in relation to man's activities.

The trace element distribution patterns from 240 bottom sediment sampling sites performed during the months of June and July 1976 for the preliminary geochemical survey indicated that the north central sector of the North Creek Watershed is an area of high metal content.

A spring at the anomaly site seems to issue mainly from a dolomitic- shale bedrock source due to its characteristic water quality. The peculiar water chemistry was apparently derived from oxidation of sulphide minerals and dissolution of gypsum crystals present in the underlying, mineralized bedrock.

A chemical and textural study of the lithology of the well core sediments and bedrock drilled adjacent to the anomalous site revealed the migration path of the groundwater flow with respect to the selective mobility of certain elements in this secondary environment.

Thermodynamic evaluation of the ion speciation of the major chemical constituents from the anomalous spring and surface waters showed gypsum to be supersaturated in these anomalous spring waters. Downstream from the spring, the loss of the spring's carbon dioxide in attaining equilibrium with the atmospheric carbon dioxide resulted in the surface waters being supersaturated with respect to the carbonate minerals, such as calcite, aragonite, magnesite and dolomite.

Downstream from the spring, the minor constituents, such as the heavy metals, are co-precipitated with $CaCo^3$, complexed with the sulphate radical and other inorganic ligands and form aquo metal complexes. Timewise, the relative heavy metal concentrations in these anomalous surface waters showed direct relationships with respect to precipitation and the surface water discharge of the North Creek waters.

This briefly summarized the origin and the geochemical history of the abnormality of the high metal values. The source of these high heavy metals are derived naturally from the dissolution of the bedrock mineral deposits, thus contaminating the groundwater discharge in the North Creek waters. The contribution of man's activities as a source of heavy metal contamination in these natural waters appeared to be negligible, since the implication of atmospheric pollution was proven to be minute.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

382. WHITBY, L.M., MacLEAN, A.J., SCHNITZER, M. and GAYNOR, J.D.
1978: Sources, Storage and Transport of Heavy Metals in Agricultural Watersheds; Report, Task Group C (Canadian Section), Activity 1, PLUARG, International Joint Commission, Windsor, 142 p.

ABSTRACT:

The objective of this project was to determine and assess the relationship between concentrations of selected heavy metals in stream water, suspended sediments, bottom sediments and soils within selected agricultural watersheds, with the aim of elucidating storage and transport mechanisms for trace elements.

Soil profile samples of the major soil types of each of the six agricultural watersheds were obtained for nutrient and trace metal analysis. Analyses of total metal concentrations (As, Cd, Cr, Cu, Hg, Mn, Ni, Pb, Se, Zn, Al and Fe) and DTPA extractable metals (Cd, Cu, Ni, Pb and Zn), as well as total carbon, organic carbon, total nitrogen, total phosphorus and pH were performed. To demonstrate field variability and the effectiveness of our sampling system, six replicate soil samples were taken within the same soil pit for most sites. In addition, four soil pits within the same soil type separated by at least one mile were sampled in one watershed. The replicate soils were analyzed for total concentrations of Cr, Cu, Mn, Ni, Pb, Zb, Al, Fe, C and N. Composites of the A horizons from each major soil of each watershed were used for the extraction of HA's and FA's. Ultimate analyses, functional group analyses, chemical degradation and identification of products were performed on each sample.

DATA:

Secondary Source; refer to Ontario Ministry of the Environment data.

383. WHITBY, L.M. and SCHNITZER, M.
1978: Humic and Fulvic Acids in Sediments and Soils of Agricultural Watersheds. Canadian Journal of Soil Sciences, Vol. 58, No. 2, p. 167-178.

ABSTRACT:

Humic and fulvic acids were extracted from suspended and bottom sediments and soils of small agricultural watersheds of Southern Ontario and characterized by chemical and spectrophotometric methods and by chemical degradation. Soil humic and fulvic acids were found to be similar to sediment humic and fulvic acids, respectively, in elemental and functional group composition and in surface structural features. Metal-binding capacities of sediment and soil humic and fulvic acids were estimated from their $CO_2H$ and phenolic OH group contents. Because watershed soils contained per unit weight considerably more humic materials than did adjacent bottom sediments, the metal-binding capacity due to humic and fulvic acids in the watershed soils was considerably higher than that due to humic and fulvic acids in the sediments. Major products resulting from the alkaline $KMnO_4$ oxidation of soil and sediment humic and fulvic acids were benzenecarboxylic and phenolic acids. The chemical, spectrophometric and degradation data indicated that sediment and soil humic substances had similar chemical structures.

DATA:

Primary Source.

384. WHITTAKER, E.J.
1922: Bottom Deposits of McKay Lake, Ottawa; Transactions of the Royal Society of Canada, Series 3, Vol. 16, No. 4, p. 141-158.

ABSTRACT:

This paper deals with an investigation of the sedimentation of McKay Lake, near Rockcliffe, Ottawa.

DATA:

Primary Source.

385. WHITTLE, D.M. and FITZSIMONS, J.D.
1983: The Influence of the Niagara River on Contaminant Burdens of Lake Ontario biota; Journal of Great Lakes Research, Vol. 9, No. 2, p. 295-302.

ABSTRACT:

Top predator and forage fish species, net plankton (>153 µm), zooplankton, and benthic macroinvertebrates from Lake Erie and

Lake Ontario were analyzed for whole body levels of trace metals and organic contaminants. Comparison of contaminant concentrations in similar aquatic food chains from both lakes indicated that levels of PCB, DDT, mirex, and mercury are significantly greater ($P<0.05$) in the biota of Lake Ontario. The Niagara River, the single largest tributary to Lake Ontario, was confirmed as a major source of organic contaminants and trace metals. Organic contaminants are adsorbed to the particulate load of the river and dispersed throughout Lake Ontario by the circulating currents. There was no significant regional difference ($P<0.05$) in the degree of contaminant accumulation by the pelagic food chain of Lake Ontario. Conversely, both inorganic and organic contaminant levels in the demersal amphipod, Pontoporeia affinis, were significantly different ($P<0.05$) between the eastern and western basins of Lake Ontario. The uptake and concentration of contaminants at the sediment-water interface is suggested as a possible mechanism to explain this observed difference.

DATA:

Secondary Source; refer to Frank et al. (1981) and Warry and Chan (1981).

386. WILLIAMS, J.D.H., SHEAR, H. and THOMAS, R.L.
1980: Availability to Scenedesmus quadricauda of Different Forms of Phosphorus in Sedimentary Materials form the Great Lakes; Limnology and Oceanography, Vol. 25, No. 1, p. 1-11.

ABSTRACT:

Sedimentary materials from eroding bluffs, suspended solids in streams, and lake bottom sediments from Lakes Ontario and Erie were cultured with the alga Scenedesmus quadricauda (Turp.) de Brébisson in modified Rodhe's medium with the sediments as the sole source of P. P uptake by the algae was related to the amount of nonapatite inorganic phosphorus in the sediments. Apatite phosphorus was not used, and the bluff samples, in which over 90% of total P was in this form, did not support algal growth. The nonapatite inorganic P fraction was highly correlated with the amounts of inorganic phosphorus extracted by three standard techniques for estimating "available P" (extraction by NaOH and nitrilotriacetic acid solutions and by H-resin) and cell uptake equaled NaOH-extractable inorganic P in several instances. Uptake of P by the cells varied from 8 to 50% of total P and from 38 to 83% of nonapatite inorganic P when measured directly. Organic phosphorus in the sediments was not utilized by the algae. Percentage utilization of total P was in general highest when total P concentration in the sediments was itself high.

DATA:

Primary Source.

387. WINN, R.
1971: A Study of the Effects of Waste Disposal Sites on the Chemistry of Stream Sediments Collected Around St. Catherines, Ontario; Brock University Department of Geological Sciences, Research Report Series No. 7, Studies in Landscape Geochemistry No. 4, 25 p.

ABSTRACT:

This study describes results obtained from the analysis of stream sediments around six Waste Disposal Areas in the vicinity of St. Catherines, Ontario, the majority of which were collected during a ten week period in the summer of 1971.

DATA:

Primary Source.

388. WONG, H.K.T., NRIAGU, J.O. and COKER, R.D.
1984: Atmospheric Input of Heavy Metals Chronicled in Lake Sediments of the Algonquin Provincial Park, Ontario, Canada; Chemical Geology, Vol. 44, No. 2, p. 187-201.

ABSTRACT:

The flux of Pb, Zn, Cu, Ni and Cd into ten remote lakes in the Algonquin Provincial Park of Ontario has been determined. Deviation from constant sedimentation rates in recent sediments depicted in the $^{210}Pb$ profiles can be related to human activities within the last 100 years. Sedimentation rates in these softwater lakes vary from 0.5 mm $yr.^{-1}$ (62 g $m^{-2}$ $yr.^{-1}$) to 2.9 mm $yr.^{-1}$ (190 g $mm^{-2}yr.^{-1}$). The corresponding present-day metal flux rates for Ni, Cu, Pb, Zn and Cd are 0.6-8.4, 0.7-9.4, 3.7-43.5, 5.0-50.3, and 0.07-0.74 mg $m^{-2}$ $yr.^{-1}$, respectively. There is an overall 2-fold enrichment for Ni, Cu, Zn and Cd in surficial sediments together with a 25-fold increase for Pb. The gyttja contain 25-50% organic matter with (organic C)/(organic N) ratios which strongly suggest high influx of allochthonous plant debris.

DATA:

Primary Source.

389. WREN, C.D. and MacCRIMMON, H.R.
1986: Comparative Bioacccumulation of Mercury in Two Adjacent Freshwater Ecosystems; Water Research, Vol. 20, No. 6, p. 763-769.

ABSTRACT:

Mercury levels were determined in sediments, clams and representative fish species in two adjacent uncontaminated waterbodies situated on the Ontario Precambrian Shield. Food

chain biomagnification of mercury occurred within both ecosystems. Significantly higher mercury levels were observed in most species resident in Tadenac Lake than in Tadenac Bay. For example, mean length adjusted fish mercury levels in Tadenac Lake and Tadenac Bay respectively, were: smelt, 0.26 and 0.12 $\mu g\ g^{-1}$; rockbass 0.34 and 0.18 $\mu g\ g^{-1}$; yellow perch 0.29 and 0.12 $\mu g\ g^{-1}$; smallmouth bass, 0.55 and 0.25 $\mu g\ g^{-1}$ and northern pike 0.86 and 0.38 $\mu g\ g^{-1}$. The observed differences in fish mercury levels between the two sites cannot be explained in terms of differences in fish growth rates, lake trophic status or fish selenium levels, but appeared to be related to sediment mercury levels and ambient water quality.

DATA:

Primary Source.

390. WYER, M.D.
1983: Nitrogen Transformations Associated with Southern Ontario Stream Sediments; Unpublished M.Sc. Thesis, Department of Geography, York University, Toronto, 224 p.

ABSTRACT:

Nitrate removal, nitrification and ammonium production rates, along with a variety of chemical and physical properties of sediments, were examined for a wide range of stream sediments from diverse geographical areas in Southern Ontario.

Nitrate removal rates ranged from zero to 432.8 mg $m^{-2}$ $d^{-1}$ for undisturbed cores and from 10.7 to 178.6 mg $m^{-2}$ $d^{-1}$ for disturbed sediment samples. High rates appeared to be associated with fine-textured and organic-rich sediments and low rates with coarse, inorganic, sediments. Nitrate removal rate was found to be most closely related with the inorganic $NH_4$ content of the sediment ($r = 0.64^{**}$) and showed weaker significant correlations with other sediment characteristics such as % organic carbon, % T.K.N. and % silt and clay.

Nitrification rates ranged from zero to 128.1 mg $m^{-2}$ $d^{-1}$. Again high rates appeared to be associated with fine-textured and organic-rich sediments. Nitrification was almost completely absent in low pH sediments from the Canadian Shield. Significant correlations were found between nitrification rate and several of the sediment characteristics analysed. The highest correlation was found with % clay ($r = 0.67^{**}$).

Ammonium production rates ranges from zero to 164.8 mg $m^{-2}$ $d^{-1}$ for undisturbed cores and from zero to 221.4 mg $m^{-2}$ $d^{-1}$ for disturbed samples. Once more high rates appeared to occur in fine-textured and organic-rich sediments. Ammonium production rate was found to be most closely correlated with the organic matter and inorganic $NH_4$ status of the sediments.

The relationships between nitrogen transformation rates and sediment characteristics were difficult to interpret due to multicollinearity between the sediment characteristics analysed.

Overall the research has demonstrated the importance of a large scale geographical approach to the study of the nitrogen cycle in stream ecosystems. As well as providing an assessment of the nature of the nitrogen cycle in Southern Ontario streams, and some general implications for the management of watersheds with respect to nitrogen loadings, the results of this broadscale study may be of use to the further study of the nitrogen cycle in streams both at a regional and a microbiological scale.

391. WYER, M.D. and HILL, A.R.
1984: Nitrate Transformations in Southern Ontario Stream Sediments; Water Resources Bulletin, Vol. 20, No. 5, p. 729-737.

ABSTRACT:

The transformation of nitrate was investigated in diverse stream sediments from six areas of Southern Ontario, Canada. Laboratory experiments conducted with intact 0-5 cm depth sediment cores overlain with aerated 5 mg/l nitrate-N solution revealed considerable nitrate depletion during a six-day period as a result of denitrification and nitrate reduction to ammonium. Nitrification and ammonification also occurred simultaneously with nitrate reduction in many stream sediment. Mixed 0-5 cm depth sediments collected from 81 stream sites were used to examine the relationship between microbial nitrate removal and sediment characteristics. Rates of nitrate-N loss from aerated 5 mg/l nitrate-N solutions overlying these sediments ranged between 11 and 171 mg/$m^2$/day for a 24-hour incubation period. Rates of nitrate loss for the 24-hour period exhibited a significant positive correlation (r=0.72) with sediment ammonium content. Organic carbon, total nitrogen and sediment texture also had significant but weak correlations with nitrate loss.

DATA:

Primary Source.

392. YOUNG, M.
1979: A Modified Spread Plate Technique for the Determinations of Concentrations of Viable Heterotrophic Bacterial; In: Methodology for Biomass Determinations and Microbial Activities in Sediments, C.D. Litchfield and P.L. Seyfried, Editors, American Society for Testing and Materials, Special Technical Publication, No. 673, p. 40-51.

ABSTRACT:

Four techniques for the enumeration of viable heterotrophic bacteria were evaluated for use with environmental samples.

Factors being sought were an economical use of materials and time and a superior level of bacterial recovery. The techniques compared in this study were pour plate, spread plate, membrane filtration, and the modified spread plate technique (spot plate).

Eighty-four water and thirty-two sediment samples were analyzed for heterotrophic bacterial concentrations using the four methods under study. A statistical analysis of the data by a factorial analysis of variance and a t test indicated that there was no significant difference in the recoveries of the spread plate and spot plate techniques. Both of these produced superiod recoveries to the membrane filter and pour plate methods. Poorest recoveries were obtained with the pour plate for water and membrane filter for sediment.

The spot plate method was determined to be the most appropriate method for our purposes, since it was superior in most areas of interest to the other methods tested.

DATA:

Primary Source.

# SUBJECT CROSS-REFERENCE INDEX

SUBJECT — REFERENCES


1. AGGRADATION/DEGRADATION: 18,23,203,346.

2. ALBANY RIVER: 164, 210, 211, 310.

3. ALGONQUIN PARK LAKES: 59, 194, 389.

4. ATTAWAPISKAT RIVER: 164, 165, 210, 211, 274.

5. AUSABLE RIVER: 153, 269, 308.

6. AVON RIVER: 61, 62, 104, 124, 283.

7. BED/BOTTOM SEDIMENTS: 2,3,4,5,10,11,12,15,16,17,19,20,21,22,24,25,26,27,28,29, 30,31,32,33,35,36,38,39,40,41,42,47,48,49,53,54,55,56,59,70,71,72, 74,75,78,79,80,81,82,83,84,85,87,90,91,92,93,94,95,96,98,100,101, 102,103,104,105,109,110,111,112,116,117,118,121,122,123,124,125, 127,131,132,133,134,135,136,137,139,140,141,142,143,145,147,148, 150,152,154,155,157,158,159,164,165,167,169,170,171,172,173,174, 175,176,177,178,179,180,181,184,186,190,191,194,195,197,198,199, 200,201,204,206,207,208,209,210,211,214,215,216,217,219,220,223, 224,225,226,227,228,229,230,231,232,233,234,237,245,246,247,248, 249,250,251,252,253,254,255,257,259,260,269,274,275,277,279,281, 282,285,286,289,292,293,294,295,296,297,298,299,300,301,302,303, 304,308,310,311,314,315,316,317,318,320,321,323,325,326,327,328, 335,336,340,347,348,350,351,353,354,356,357,358,359,360,362,363, 364,365,366,370,371,377,379,380,381,382,383,384,386,387,389,390, 391,392.

8. BEDLOAD: 49,72,84,86,87,102,214,317,318,340,355,378.

9. BIG CREEK: 10,61,62,66,214,215,216,217,221,309,329,330,331,333.

10. BIG OTTER CREEK: 10,60,66,269,309,329,330,331,333,343.

11. BLACK RIVER: 256,275.

12. BONNECHERE RIVER: 98,288.

13. BURCHELL LAKE: 47,48.

14. CANAGAGIGUE CREEK: 8,14,32,38,39,40,46,63,66,149,154,189,269,308,309,327, 329,330,331,333,354,373.

15. CATARAQUI RIVER: 116.

16. CATFISH CREEK: 10.

17. CHALK RIVER: 116,117.

18. CLEARWATER LAKE: 33.

19. CONTAMINANTS/POLLUTANTS/INSECTICIDES: 1,3,6,11,12,13,15,17,19,28,29,30,31,32, 34,41,42,43,47,48,49,50,52,.73,77,88,95,97,105,106,107,108,109,110, 111,112,113,114,115,118,122,123,125,131,132,133,145,148,152,155, 157,158,159,169,172,173,174,175,176,177,178,179,180,181,182,183, 184,185,190,195,196,197,198,199,202,209,210,211,214,215,216,217, 219,220,224,225,228,233,234,235,237,245,246,247,248,249,250,251, 253,255,256,258,260,261,267,269,279,283,284,285,286,289,295,296, 297,298,299,300,311,312,316,317,318,321,347,360,361,362,364,365, 375,377,379,380,381,385,389.

20. COOKSTOWN CREEK: 43.

21. COOKSVILLE CREEK: 126.

22. CREDIT RIVER: 126,243.

23. CROSS-SECTIONS: 18,22,37,78,79,80,81,82,83,104,237,314,336.

24. DEER CREEK: 23,23.

25. DETROIT RIVER: 41,95,110,133,148,157,190,191,199,226,228,233,295,296,347,362.

26. DODD CREEK: 276.

27. DON RIVER: 187,197,294,392.

28. DUFFIN CREEK: 136,137,138,139,141,142,288.

29. EKWAN RIVER: 274.

30. ENGLISH-WABIGOON RIVER SYSTEM: 5,30,31,34,118,155,156,311,312.

31. EROSION: 57,61,64,65,67,76,83,102,119,126,152,160,161,162,163,193,203,212, 243,305,319,3367,372,386.

32. EXPERIMENTAL LAKES AREA: 20,135,322,323,324,356.

33. FAREWELL CREEK: 35.

34. FIFTEEN MILE CREEK: 290.

35. FORTY MILE CREEK: 256.

36. GANARASKA RIVER: 346.

37. GIGNAC LAKE: 24,25,26.

38. GOULAIS RIVER: 380.

39. GRAND RIVER: 6,13,14,64,107,119,146,195,204,218,261,288,374,375.

40. HARMONY CREEK: 35,340.

41. HARRICANA RIVER: 274.

42. HEART LAKE: 392.

43. HOLIDAY CREEK: 308,373.

44. HUMBER RIVER: 66,128,129,130,142,143,197,294,309,329,330,331,333,349,392.

45. INDIAN LAKE: 116.

46. INNISFIL CREEK: 43.

47. IRVINE CREEK: 4,205.

48. KENOGAMISIS LAKE: 282.

49. KETTLE CREEK: 10,276.

50. LAKE SIMCOE AREA: 108,275.

51. LITTLE AUSABLE CREEK: 308.

52. LITTLE PIC RIVER: 288.

53. LITTLE ROUND LAKE: 19,213,348.

54. LUMSDEN LAKE: 9.

55. MADAWASKA RIVER: 98.

56. MAGPIE RIVER: 288.

57. MAITLAND RIVER: 7,16,66.

58. MAJOR ELEMENTS: 20,24,26,27,33,36,47,116,191,206,213,228,229,232,239,242,257,
269,271,280,293,366,382,388.

59. MANITOUWADGE LAKE: 47,48.

60. MATTAWA RIVER: 98.

61. MAFARLANE LAKE: 33.

62. MCKAY LAKE: 384.

63. METALS/HEAVY METALS: 1,2,5,9,13,27,28,29,33,43,47,48,49,50,51,52,53,54,55,56,
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231,232,233,245,247,248,251,252,254,259,261,269,274,277,278,279,
281,282,285,286,288,289,290,297,298,299,310,316,317,321,324,325,
326,328,350,351,353,354,359,362,364,365,378,379,382,387,388,389.

64. METHODS/TECHNIQUES: 14,60,73,99,153,166,171,176,178,208,236,270,287,292,308, 338,339,343,344,345.

65. MISSISSIPPI RIVER: 98,185.

66. MODELLING: 4,8,37,46,61,62,63,64,65,68,102,128,129,130,209,309,313,329, 330,331,332,333,349,371.

67. MOIRA RIVER/MOIRA LAKE: 201,229,230.

68. MOOSE RIVER: 210,211,274,310,380.

69. MUSKOKA/HALIBURTON AREA: 55,56,70,89,90,91,92,93,108,217,370,371.

70. NIAGARA RIVER: 12,28,29,77,105,158,159,181,182,183,196,231,232,253,255,377, 380,385.

71. NIPIGON RIVER: 21,74.

72. NITH RIVER: 336.

73. NORTH MAGNETAWAN RIVER: 341.

74. NOTTAWASAGA RIVER: 18,139,140,141,142,203.

75. NUTRIENTS: 1,3,6,13,20,38,39,40,43,44,45,49,50,51,52,55,56,57,58,71,73,89,92, 93,97,104,116,123,124,127,131,132,133,136,137,139,140,141,142,143, 145,146,149,152,155,158,168,181,194,206,207,208,213,218,221,223, 226,227,232,233,238,239,240,241,251,264,267,268,269,273,274,275, 276,277,278,281,282,284,288,290,293,308,310,320,322,323,325,326, 327,328,335,352,357,382,386,391.

76. OTTAWA RIVER: 11,96,97,98,171,172,173,174,175,176,177,178,179,180,184,186,219, 220,224,225,252,254,259,286,297,298,299,300,315,316,317,318,321, 364,365,376,378,379.

77. PARTICLE SIZE: 4,5,10,18,22,27,35,36,48,49,50,53,65,72,78,79,80,81,82,83,86, 87,100,108,121,123,127,133,139,140,142,148,149,153,154,164,165,176, 179,185,192,193,200,204,210,211,219,226,227,228,230,231,269,271, 286,290,294,297,299,314,315,316,317,318,321,325,326,327,336,343, 354,357,358,362,364,378,390.

78. PETERS LAKE: 36.

79. PINE RIVER: 18.

80. PLUARG WATERSHEDS: 6,13,17,50,51,52,65,73,101,102,106,108,109,111,112,113,114, 115,145,146,149,150,151,168,202,218,222,263,267,268,278,287,352, 361,367,368,375,381,382.

81. RESERVOIRS: 78,79,80,81,82,154,166.

82. RIDEAU RIVER: 98,185,252,254,259.

83. RIVER MORPHOLOGY: 4,16,18,23,119,164,165,205,314,315,317,378.

84. SAUGEEN RIVER: 6,13,107,145,261,288,374,375.

85. SECOND LAKE: 24,25,26.

86. SEDIMENTATION/SEDIMENTATION RATES: 7,16,21,24,35,36,69,74,89,92,93,120,124, 126,154,160,161,162,166,194,204,212,243,282,290,305,336,340,346, 358,388.

87. SUSPENDED SEDIMENT: 1,3,5,6,7,8,9,10,13,14,17,18,27,28,29,30,31,32,34,35,37, 43,44,45,46,49,50,51,52,57,58,60,61,62,63,64,66,67,68,72,77,78,79, 81,82,83,84,85,86,87,88,97,99,100,104,105,106,107,108,110,111,113, 114,115,122,123,128,129,130,132,135,137,138,143,145,146,149,150, 151,152,153,155,156,157,158,159,160,161,162,164,165,168,170,174, 180,181,182,183,185,187,190,192,196,202,211,213,215,218,219,221, 222,234,235,236,238,239,240,241,242,244,245,247,250,251,253,256, 258,261,262,263,264,265,266,267,268,269,270,271,272,273,275,276, 278,280,283,284,286,287,288,290,293,295,305,306,309,311,312,313, 322,324,329,330,331,332,333,336,337,338,340,341,342,343,344,345, 349,352,355,358,361,368,369,373,374,375,376,377,381,382,383,385, 386.

88. SUSPENDED SEDIMENT CONCENTRATION: 43,49,66,84,86,87,151,152,269,290,340,358, 369,376.

89. SUSPENDED SEDIMENT LOAD: 8,35,49,57,58,66,67,68,84,87,115,153,163,264,266, 272,283,340,355.

90. SEVERN RIVER: 210,274,310,380.

91. SHEBANDOWAN LAKE: 47,48,350,351.

92. SHERIDAN CREEK: 122,123,126.

93. SIXTEEN MILE CREEK: 290.

94. SOUTH NATION RIVER: 83,98.

95. SPANISH RIVER: 273.

96. ST. CLAIR RIVER: 11,15,37,41,72,88,148,190,191,200,209,235,237,258,260,279, 285,296,314.

97. ST. LAWRENCE RIVER: 42,127,195,284.

98. ST. MARY'S RIVER: 132,190.

99. STURGEON LAKE: 47,48.

100. SUDBURY AREA LAKES: 2,53,54,71,147,206,207,223,245,246,247,248,249,250,251, 277,281,303,325,326,353,359.

101. SWIFTS BROOK: 39,141,308,320.

102. TADENAC LAKE: 388.

103. TALBOT LAKE: 334.

104. THAMES RIVER: 61,64,66,131,217,309,329,330,331,332,333,345.

105. TRENT RIVER: 44.

106. TURKEY LAKES AREA: 75,134,167,195,223,249,301,302,304,335.

107. TWELVE MILE CREEK: 103,121.

108. TWENTY MILE CREEK: 290,381.

109. TWIST LAKE: 11.

110. UPPER MANITOU LAKE: 47,48.

111. WATER QUALITY: 1,5,6,9,12,15,28,,29,32,35,41,43,52,56,57,58,77,98,104,105,109,
111,112,117,124,127,131,132,136,137,138,140,143,145,151,155,158,
159,183,193,196,198,199,216,217,227,232,235,240,241,242,244,248,
251,263,265,267,268,270,273,275,276,277,279,280,281,282,283,287,
295,300,310,312,325,326,328,334,347,357,382,388.

112. WILTON CREEK: 6,27,76,271,293.

113. WINISK RIVER: 210,211,274,310.